NAVY CIVIL ENGINEER

ON THE COVER

The Navy's newest weapon in the nation's defense arsenal, the **Trident** submarine, will be harbored in extensive support installations now under construction by the Naval Facilities Engineering Command in the Pacific Northwest, as told on page 4. A related test facility is also under construction in Central Florida, which is reported on page 7. Illustrator Barbara Gray displays on the cover **Poseidon** (the Greek god of marine life, whose Roman mythological counterpart is **Neptune**) holding the three pronged trident which lends its name to the Navy's latest nuclear-powered, missile equipped underseas craft.

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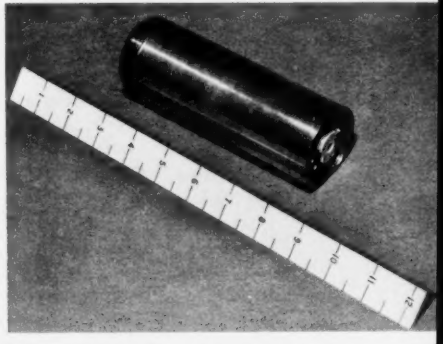
A city loves this man. Find out why beginning on page 18.

"What difference does it make?" Read all about it beginning on page 9.



A "Superbattery?" You'll get a charge out of the article on page 37.

To Test A Trident

BY KENNETH M. ROBERTSON, P.E.
Southern Division, NAVFAC

• Cape Canaveral, Fla.

At the southern end of Cape Canaveral, Florida, is the Naval Ordnance Test Unit (NOTU) which tested the Navy's first and second generation submarine-launched missles, Polaris and Posiedon.

With the Navy on the threshold of development of its third generation submarine-launched missile — Trident — Southern Division, Naval Facilities Engineering Command, was tasked in early 1972 with providing Program Cost Estimates (PCEs) and final design for the first shore facilities to support Trident missile test launchings at the Cape.

Existing facilities had to be modified to accept the much larger and heavier Trident missile. In addition, an entirely new port facility had to be constructed because of the Trident submarines' size and the explosive safety radius of the Trident missile.

With completion of Launch Complex 25 modifications, the first facility for Trident missile testing was turned over to NOTU.

Projects authorized for the FY74 program were: Launch Complex 25 modifications; guidance telemetry building alterations; missile checkout building alterations; and wharf and turning basin construction.

The Launch Complex 25 project involved minor modifications to the missile access stands, an addition to the blockhouse for the new fire control system, new cabling, a new un-interruptable power source (UPS), and hardening the existing blockhouse to withstand the greater explosive hazard of the Trident missile motors.

This project was the most time critical since highly complicated electronic equipment had to be installed and checked out by personnel of NOTU after the construction contractor completed the project. Also, after the project reached the 100 percent design complete stage, explosive criteria were changed, resulting in a major redesign effort.

The Guidance/Telemetry Building project involved electrical alterations, provision of a UPS unit, a new loading platform, and exterior paving.

The Missile Checkout Building project involved modifications to four buildings. Mechanical, electrical, and architectural work was also accomplished.

The Wharf and Turning Basin project involved the "lion's" share of work. Included in this project were a wharf, turning basin, access channel, entrance channel, and portal crane. The remainder of this article will be devoted mainly to the Wharf and Turning Basin Project.

At the time of PCE preparation, an Environmental Impact Assessment (EIA) was made. It was determined an Environmental Impact Statement (EIS) would be needed since the new turning basin required dredging 10,200,000 cubic yards of material from the original highground site.

The Navy coordinated environmental aspects with state, federal, and other interested environmental groups to avoid damaging the environment during construction. As a result, the project has proceeded smoothly.

The turning basin site lies north of the Port Canaveral Channel and some 2,000 feet from the Atlantic Ocean. Its dimensions are roughly 800 ft X 1000 ft. The access channel connects the turning basin with the Port Canaveral Channel and is 500 feet wide by about 1000 feet long.

The original site consisted of rolling dunes overgrown with grass and scrub bushes. Elevation averaged about +17 feet MLW. Turning basin depth and access channel was set at -41 feet MLW, plus an allowable two feet of overdepth.

This made necessary dredging a basin 58 feet deep when measured from the

The blockhouse at Cape Canaveral (left and left below) had to be "hardened" to assure safety as the Trident missile has a much greater explosive capacity than either the Polaris or Poseidon. Hardening took the form of another layer of concrete and steel. Above right is an aerial view of the turning basin and wharf. Below right is a picture of work in progress on the Trident wharf.

existing ground. Side slopes on the project were four horizontal to one vertical and the water line periphery was rip-rapped.

With such a great quantity of dredged material came the enormous problem of disposal. Generally, the soil between the surface and elevation -25 feet MLW consisted of clean sand and shell fragments. Below elevation -25 MLW the material was sand and shell fragments mixed with various quantities of clay.

The upper material was of excellent quality, suitable for beach nourishment. It so happened the Army Corps of Engineers was contemplating a beach nourishment project south of the Port Canaveral Channel.

Sand for this project was to be pumped from the Port Canaveral Channel north jetty to the nourishment site. Timing of two projects worked out perfectly and a portion of this excellent sand was deposited on the beach to form a berm to elevation +10 MLW by 500 feet wide and over two miles long.

The remaining spoil was deposited in two diked spoil areas east and west of the turning basin site. Tops of the dikes were at elevation +43 MLW. The remaining excellent material was deposited in the spoil area west of the site and all material from below elevation -25 MLW was deposited in the east spoil area.

Dredging in the turning basin and access channel was accomplished by contract with pipeline dredges.

The entrance channel portion of the project began at the intersection of Port Canaveral Channel and the turning basin access channel and extended

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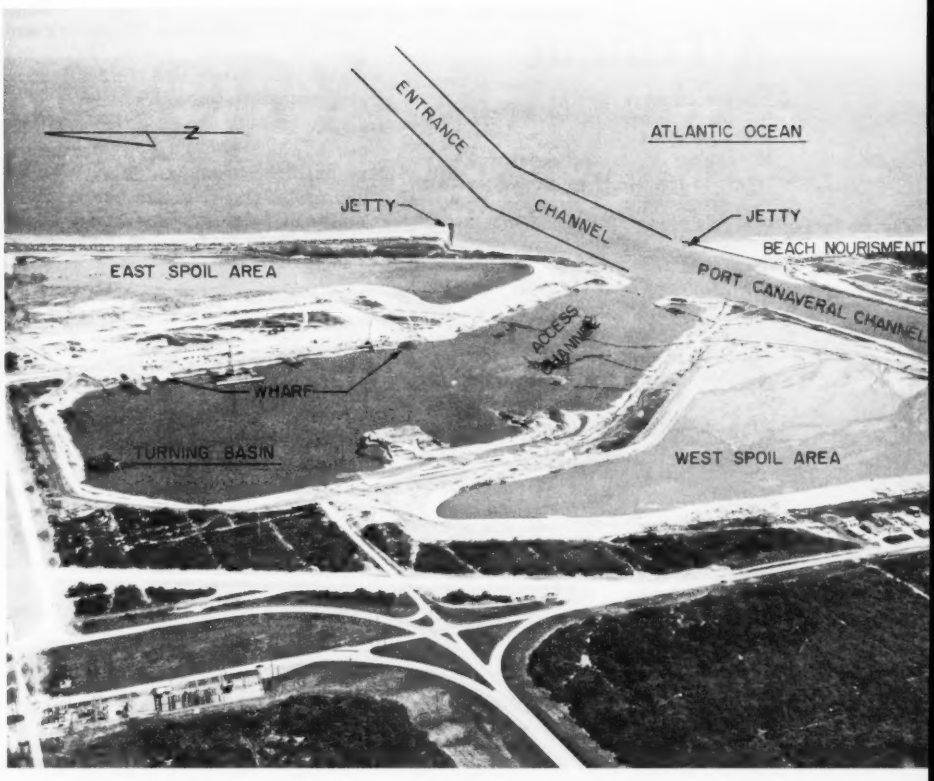
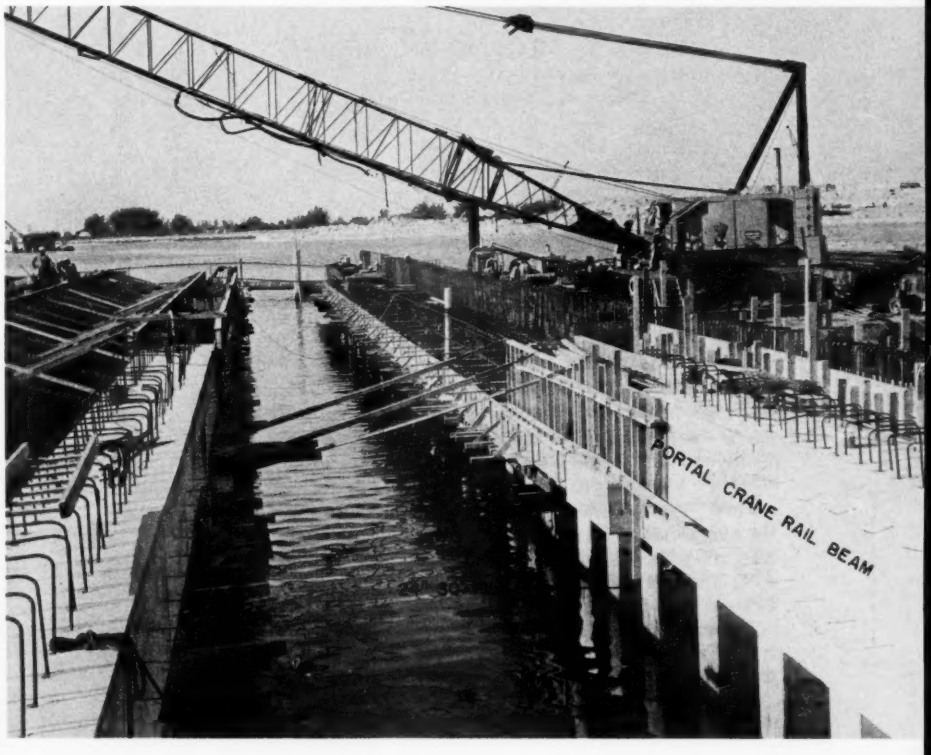




To Test A Trident

(Continued from page 5)

some six miles eastward into the Atlantic. Project depth on this channel varied from -41 feet MLW to -44 feet MLW at the eastern point.

This dredging was accomplished by the Army Corps of Engineers using hopper dredges. Spoil was deposited in a designated area at sea.

The 1200-foot long wharf was designed to accommodate two Trident submarines, each 565 feet long. The wharf is free standing, supported by prestressed concrete piles; cast-in-place concrete caps; pre-cast, pre-stressed concrete deck units; and a six-inch poured concrete topping.

The wharf is 68 feet wide and is connected to the shore by three land bridges, each 60 feet wide. A concrete sheet pile bulkhead separates the land and water and runs the full length of the wharf.

Services are provided on the wharf to provide ship power, utility power, water, shop air, high pressure air, sanitary sewers, fire protection, and communications. The wharf is provided with a steel fendering system for the entire 1200 feet.

The wharf also included tracks for a portal crane being procured by the Great Lakes Branch of Northern Division. Track gage is 40 feet and crane capacity will be 120 tons. The crane will be used for loading Trident missiles onto the submarines.

The project also includes a support building with meeting rooms, maintenance facilities, communications and mechanical equipment.

Since there are no sewage treatment facilities in the area (septic tanks only) a new treatment plant had to be constructed. Biological treatment processes could not be used because of infrequent and eratic loading cycles. A physical — chemical type treatment system was specified.

There was one major problem on the wharf project at the beginning which might be of particular interest. The wharf is supported on concrete piles.

Three sizes of piles were required: type "A" — 116 tons, type "B" — 86 tons and type "C" — 55 tons. For type "A" piles the contractor was given the option of using a 36" O hollow pile, a 36" octagonal hollow pile or a 30" square pile with hollow center section and solid ends. The contractor opted for 36" O piles.

Type "B" piles were 24" square and type "C" were 18" square. Bid length for all piles was 95 feet. Test piles were also required as well as load tests.

After several test piles were driven, one of the type "A" piles was pulled for inspection and was found to have logitudinal cracks in the bottom three sections. Piles were cast in 16 foot sections and joined.

These longitudinal cracks occurred along the grouted posttensioning strands. There were 12 of these strands and cracks occurred about three per pile and ranged in size from hairline up to 1/8" at the surface.

A load test was conducted on one of the in-place type "A" piles. The load test was carried to the required load without failure. However, this pile was also pulled and longitudinal cracks were present in the bottom sections. This caused great concern for the long term stability of the piles.

In search of a possible substitute for the type "A" 36" O hollow piles, a type "B" 24" square pile was loaded to failure. It was found that by increasing the length to 100 feet the type "B" pile could be used in place of the type "A" piles with the required safety factor.

The exception to this was that a quantity of the 36" O pile sections had been cast. To use these sections, a design change was made modifying the tip of the pile and these were used in one row. In the other two pile rows which required type "A" piles, 24" square piles 100 feet long were used.

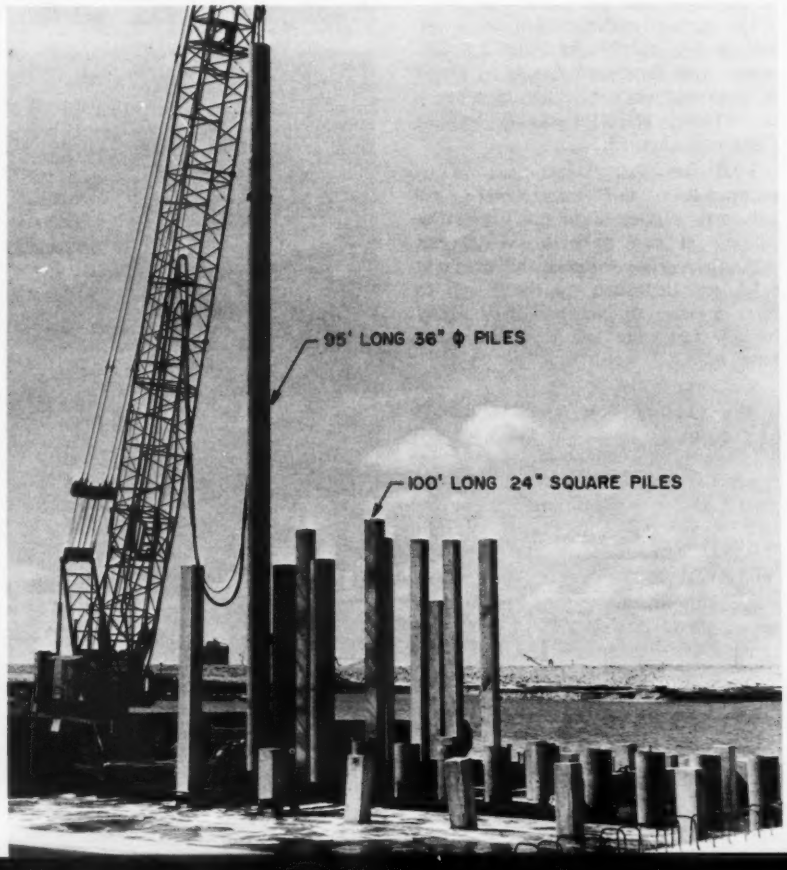
After all data were in, the consensus on the cause of the longitudinal cracks was instantaneous pore pressure in the granular soil at the open end of the piles. This type pile is very weak relative to internal forces acting outward on the pile shell.

Any use of this type pile in the future should be closely scrutinized before being incorporated into a project.

All the above projects have either been completed or are nearing completion. The wharf project has a scheduled completion date of September 1976. However, current estimates are that the project will be completed by March of 1976.

Total cost of the projects under construction, or completed, in the FY74 program was $37 million.

In addition, Southern Division is currently in the design stages of three more Trident related projects at Cape Canaveral.



KEEPING TRIDENT'S DRYDOCK DRY

BY ALTON S. BRADFORD, P.E.
Head, Civil/Structural Design Branch
Officer In Charge Of Construction, TRIDENT

• Bangor, Wash.

The development of concepts and preliminary designs for Trident base waterfront structures has presented many challenging design and construction problems.

Their identification and solution have afforded a unique opportunity for developing engineering solutions based not only on monetary constraints and operational requirements but on environmental impact considerations as well.

Although all Trident facilities have been planned with environmental protection as a cardinal objective, the Trident graving dock stands out as a classic example of a difficult engineering design problem solved within the framework of environmental restrictions.

During preliminary planning and programming of the Trident drydock in 1972 — which considered four possible sites — many aspects of the project which affected the environment were addressed. These included dredging volumes, spoil areas, land acquisition, tidelands, land fills and air and water pollution from drydock operations — to name a few.

However, it was not until the announcement in February 1973 of Bangor, Washington, as the site for the Trident base and initiation of the Master Plan and Environmental Impact Statement that same year, that the full extent of the drydock site location design problems were recognized.

The Bangor Annex is located on the east shore of a 300 foot deep north-south body of water known as Hood Canal. The Annex covers 7,000 acres and has five miles of shoreline. The terrain is steep and heavily wooded. Characteristic soils consist of glacially deposited compacted or recessional sands, gravels and silts.

Water in the Hood Canal is of the highest quality and marine and wild life abound along its shoreline. The intertidal zone supports rich clam and oyster beds and is also the migratory path for 75 percent of the canal's pink and chum salmon which make their way seaward annually.

During the initial stages of Master Plan development in late 1973, the window for siting the drydock was developed. This window was bounded on the north and south by explosive safety quantity distance arcs measured from the property boundary to preclude a major enviornmental impact: land acquisition.

The requirement that no land fill type structure be constructed in the intertidal zone and high artesian pressures close to shore dictated the location of the drydock's centerline to be, at a minimum, at the -50 foot contour. The offshore limit of construction was set at the -120 foot contour which was considered the economic and state-of-the-art limit with respect to deep water pile construction.

To make maximum use of the limited shoreline, other waterfront facilities in addition to the drydock had to fit into this window. Therefore, a triangular structure composed of the north-south oriented drydock and two refit piers connected to each end of the drydock and joining at a westerly apex evolved.

This structure, referred to as the "delta" and connected to the shore by north and south pile supported access trestles, was oriented for minimum dredging at the drydoek and such that no dredging would be required at the piers.

THE ARTESIAN AQUIFER

During soil explorations in support of the Master Plan, five borings along the five mile coast line recorded artesian water, a condition which, in itself, normally presents no major problem in design and construction of waterfront facilities.

Test drilling in progress at Bangor on the Hood Canal.

However, during the soil boring program in mid-1975, in support of the design of Refit Pier #1, a relatively high (+30 to +50 feet above MLLW) artesian pressure was encountered.

This led to the modification and extension of the pier-soil boring program to include four preliminary borings at the exact site of the drydock and an extensive geotechnical investigation to a distance offshore of about 1,500 feet and along about one mile of shoreline.

The geotechnical investigation indi-

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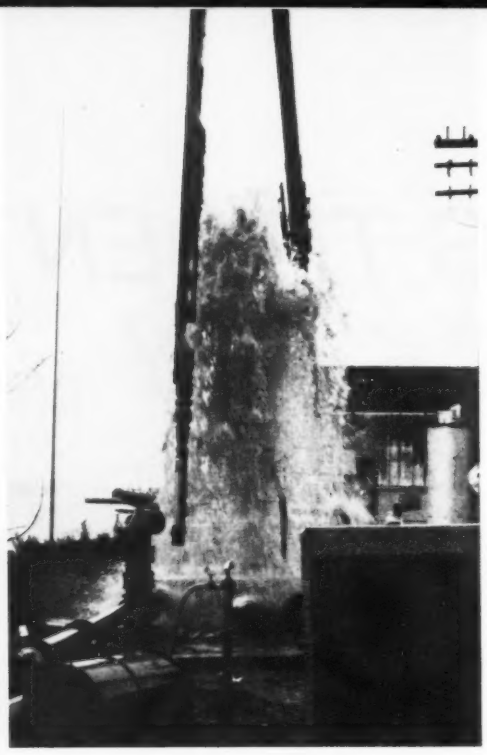


Drill rig at Bangor probes for the artesian aquifer (far left) and finds it! Tests were needed to assure work on the "Delta Dock" would not affect local water supplies.

(Continued from page seven)

cated the extent and level of artesian pressure would be a primary factor in the design of the drydock and that there was not a more advantageous site for the drydock within the site window.

PRELIMINARY INVESTIGATION

To determine the magnitude of artesian pressures and flows to be used in establishing the drydock concept, as well as any other ramifications of drawing down (relieving) the aquifer at the drydock site, an initial pump test was conducted on 16 Dec. 1974.

Because of the many unknowns and the preliminary nature of the test, it was kept austere. However, because of the possible off-site effects, the pump test was monitored by recording the water levels in a number of water resources exploratory wells throughout the Bangor Annex.

During this test, a pumping rate of 1090 gpm achieved a significant drawdown of the test well while observation wells close to the test well were drawn down amounts varying from two to five feet. Salt water intrusion did not occur to the test well.

Results of this test indicated that a quite permeable, directional artesian aquifer lay beneath the drydock site and was venting in the Hood Canal seaward of the site and that there would be a definite artesian drawdown on the Bangor Annex.

However, the possible effects of any continuous pumping were still uncertain. It was concluded that relief of the artesian pressure at the site to permit both construction and subsequent operation of the drydock was feasible. However, because of residual artesian pressure, the stability of the site in the event of an earthquake would need further study.

FURTHER INVESTIGATION

Although questions of the feasibility of designing, constructing and operating the drydock were answered, additional data were required to proceed with premilinary and final design of the facilities. Site stability during an earthquake, effect on Navy on-station and private off-station water supply systems and underground natural reservoirs, probable pump rates, possible use of relief systems for water supply and excess fresh water resulting from the aquifer relief system, were just a few of the unanswered questions.

Therefore, a second pump test was conducted using the test well from the first pump test but with a change in pumps to allow a higher pump rate to obtain a more extensive drawdown of the aquifer.

The number of off-shore soil borings was greatly increased and expanded beyond the delta site. Piezometers were installed in many of these borings and set to read pressures in various strata.

On-shore wells, used in the original on-base water supply investigation, were also expanded to the eastern most station boundary and continuous water level recording devices were installed. Salinity, tide and barometric pressure were monitored.

The test began on 14 Apr. 1975 and was concluded on 24 Apr. 1975.

The pumping rate varied between 1850 gpm and 2050 gpm and resulted in a drawdown of 49 feet below MLLW at the test well. However, all piezometers returned to normal within approximately four days after the test.

No salt water intrusion was recorded either in the pump well or any observation wells during the test and there was no significant drawdown at the eastern station boundary. It was determined that the aquifer was definitely bounded on the northern side and appeared to have a boundary (divide) on the southern side and was venting almost entirely into the Hood Canal in the area of the drydock site at the rate of 2,000 to 4,000 gpm.

After completion of the pump test and related studies, it was concluded the underwater slope was adequately stable under earthquake loads for the in-situ condition and for the piers, but that some reduction in artesian pressure was warranted for the drydock.

The possible affect on off-station private wells of pumping the aquifer and the sphere of possible salt water intrusion were not so severe as originally anticipated. However, they will require consideration during the design and construction of the facility.

Four basic drydock schemes were presented as feasible: a partially relieved drydock, constructed in the dry; a gravity drydock, built in the wet; a gravity drydock, built in the dry; and a gravity drydock, with the floor constructed in the wet and the walls constructed in the dry.

RELIEF SYSTEM

Based on feasibility of construction and operation, environmental considerations, construction time, cost and reliability, a gravity type drydock, constructed in the dry, was selected. This scheme will require pumping of the aquifer to lower the artesian head at the drydock site.

Because of the two primary environ-

(Continued on page 42)

What Difference Does It Make?

• Monterey, Calif.

In this case the difference can make an important difference!

By LCDR STEPHEN STEWART, CEC, USN
Naval Postgraduate School

Seemingly a statement of disgust or lack of commitment, "What difference does it make?" describes a pattern of thinking that can be quite useful in construction planning. This article examines two kinds of difference. One is fundamental to the construction process and includes things that make construction different from manufacturing, and which contribute to the uniqueness of construction projects.

The second category of difference involves planning procedure where differences often produce communication problems. The Seabee battalion is the model for discussion because its role in construction is analogous to the contractor's and, more importantly, because the Seabee construction plan must not only be a communicative tool but must survive, on its own merit, as one construction organization is relieved by another.

"THE PROCESS"

Reproducibility—The goal and obstacles. The crux of argument is the scientific method: for the scientist to draw a conclusion, his experiment *and* the results must be reproducible. Having achieved these conditions, the original hypothesis becomes a useful predictive statement.

Manufacturers use this concept so they can accurately express costs and profits in terms of money per unit made. Profits for automobile manufacturers are measured in dollars and cents per automobile; a dairy's profits are but a fraction of a cent per gallon of milk processed. Why can't costs and profits be so finely measured and predicted in construction? Not saying it can't or hasn't been done on some jobs, there remain differences between construction and manufacturing that make construction more difficult to predict. Following are examples:

Plant. In manufacturing, the plant is tailored to operations. The construction plant is the facility under construction, and its configuration changes from day to day.

Environment. Climate can be controlled in a factory. With the exception of some finishing operations, the construction climate is, at best, sometimes predictable.

Production interfaces. Whether a factory uses the assembly line or small group concept, an individual has contact with others. Sometimes, plant layout and work flow patterns fix interfaces so rigidly worker communication is neither required nor desired.

In construction, production interfaces vary. On one job, electricians may follow the wall closing crew to install surface conduit and fixtures; on another, they may precede wall closers to install concealed wiring; on still another, the two crews may merge to button up partitions as they go.

Worker task requirements. In manufacturing, human operations remain relatively constant. Worker skills are used repetitively permitting accurate definition of deficiencies which may be corrected through training or eliminated by modification. The construction worker frequently changes operations. An electrician may install building service one day, interior wiring the next and fixtures the third. Operations change frequently requiring conscious thought from the worker, increasing the opportunity for variance.

These differences may be summarized by saying construction is labor intensive as opposed to the capital intensive nature of manufacturing. This analysis may lead a construction manager to lament because so much of his satisfaction is based on the proper actions of human beings rather than machines. It doesn't seem the situation will soon be changed.

There is reason for joy as well. The experience of manufacturers indicates construction may have been spared 75 years of learning at the school of hard knocks which, for manufacturing, began with Taylorism and is reaching fruition at present. Casual reading of a management journal finds increasing emphasis placed on human problems.

And at the vanguard of thought is the idea the increasing permanence of a hired labor force and the capital flexibility provided by large scale operating leases may alter the *short run* cost analysis procedures within the business environment.

It is not inconceivable that even on the balance sheet, manpower will be the dominant resource in industry, not only for the long run but for the short run as well.

(Continued on next page)

'even the cook who professes no recipe ...has basic rules'

Regardless of one's attitude toward the differences, they do not go away. To plan exclusive of their consideration is futile. Interestingly, and somewhat paradoxically, these inherent differences among construction projects are reflected in planning methodology. They tend to affect our thinking about how a given job should be planned. Things that make construction challenging and fun also corrupt our procedures when we are not careful almost to an extreme.

"PLANNING"

Planning methodology — evasive, but surmountable obstacles. The scientist who does not have an established rigor for his experiment is in trouble. Even the cook who professes to have no recipe has some basic rules unless each meal is intended truly to be a surprise.

In many ways the construction planner-estimator is like a cook. Historically, the estimator has had an input of plans and specifications, has done his work and turned out a finished procurement and construction plan. Input and output have been tangible and whatever has happened in between has been the estimator's responsibility.

Stressing an iconic thinking ability, texts and manuals have portrayed the estimator as much an artist as practitioner. To be proficient at his task, the aspirant had to undergo an arduous working apprenticeship until the process of transforming plans and specifications into time and resources requirements has become habit.

However, a completed procurement and construction plan is not enough for today's work. Project scope and complexity require copious recorded support for nearly all contractor construction plans. Further demands are placed on the Seabee organization by Battalion rotation and movement of individuals within the unit. In the Seabee case, the cook orders the ingredients, sets the table, makes the salad, preheats the oven and goes home.

It's obvious the success of the meal depends on the quality and clarity of the recipe left behind. Given that a recipe is left, where does the new cook get the confidence necessary to follow it and serve the meal as originally planned?

Similarly, if a relieving project manager has only the completed procurement plan and schedule, what can he do? He must either accept the plan or re-do the whole thing. Much as he might want to accept his predecessor's work, how can he? What should he do when future performance differs from plan? What caused the discrepancy? What corrective action can be taken?

Unless the new manager is to be only a reporting agent, he has to re-do the plan to accept responsibility for getting the job done on time and at cost. If parties to the turnover do their planning in the same way, the transfer can be smooth. Differences can be chaotic.

It seems productive to standardize estimating procedures to require uniformity in expressing milestones, if not the whole procedure, and so reduce the effort required to re-do a construction plan. This should, in turn, alleviate the trauma of project turnover.

Separating the estimating process into parts is necessarily arbitrary because the process is iterative: steps are not independent and are only artificially distinct. If we examine the process to identify milestones that could be useful communicative part products, the following are reasonable steps:

- Break the project into parts
- For each part: determine a construction method, perform a quantity take-off and apply labor factors to quantities.
- Reassemble the parts in an ordered relatic .ship to show resources applied to the project over time.
- Reassemble the parts by resource to get a procurement and resource allocation schedule.

Project breakdown. An accepted starting point is to separate the project by facilities or items. This meets the need for adding or excising whole buildings, etc., to meet money constraints or changes in customer mission, and to realize a gross advantage with repetition of like structures. Within each construction item, the Uniform Construction Index is a most reasonable means of subdividing work.

The index classifies work by material and associated crafts. Inspection and quality control measures may be incorporated into the plan since specifications are normally prepared in this format.

Finally, there should be some determination of the size of a single activity in terms of resources or time for its completion. NAVFAC Instruction 5200.10B, Subj: Application of Network Analysis Systems to Construction Projects, refers to the ASPR clause 7-644.5 which states, "The detail of information shall be such that duration time of activities will range from 3 to 30 days with not over 2% of the activities exceeding these limits."

We might add some rules for choosing within these constraints; a work segment must have an observable start and finish; we must be able to tell when a particular portion of the work is done.

Secondly, the size of an activity is related to the frequency with which the manager wants to be able to adjust his allocation of resources to maintain a schedule. Or, if the resources are fixed, he wants to alert customers to an extended completion date. It seems reasonable to want 20 chances to make corrections over the life of the project, which would require activity size to be about 5% of the intended project duration.

If the 5% points are observable and measurable, the manager and his subordinates can develop interim milestones from them for daily and weekly progress monitoring. They can also construct a summary with less detail for the "big picture" people.

"FOR EACH PART. . . "

Determine a construction method. This operation is often dictated by specifications. However, there is still plenty of room for confusion. An example is the forming scheme for concrete work. Having only the quantity take-off for timber

'simple classifications: less than, equal to, more than...'

and connectors can make the forming operation a huge Chinese puzzle for the construction manager. Yet, supporting sketches and narrative for this work are often discarded by planning personnel after the quantity estimate is made.

On occasion, the designated forming materials have been combined with materials which are part of the finished product. "After all, it's all plywod and Two by . . ." To help eliminate misunderstanding, each work part should have supporting drawings and sketches as well as a narrative description commensurate with its complexity.

Perform a quantity take-off. The meticulous, painstaking pursuit of accuracy in training an estimator is often undone in practice. It's easy to sympathize with him, recalling the repetitious exercises in geometry and physics where parts of the computation became routine with exercise. Yet, how many times was a wrong answer scored "zero" because the professor could not decipher the computation?

While a specific order and format for each type of estimating calculation might prove more burdensome than beneficial, a requirement to carry units of measure throughout the calculation should prove helpful. Not only does the requirement generally force order in the procedure, but it makes computation errors involving conversion factors less likely. For example, determining the amount of water to add to soil to bring it to optimum moisture content:

Given: Desired soil dry density = 120 pcf
Existing moisture content = 8%
Desired moisture content = 13%
Quantity = 50,000 cy

$$\frac{120 \text{ lbs soil}}{\text{ft}^3} \times (.13-.08) \frac{\text{lbs } H_2O}{\text{lbs soil}} \times \frac{1 \text{ gallon } H_2O}{8.345 \text{ lbs } H_2O} \times \frac{27 \text{ ft}^3 \text{ soil}}{1 \text{ c.y. soil}} \times 50{,}000 \text{ c.y. soil} = 970{,}640 \text{ gal } H_2O$$

The scheme also shows estimate detail made when the conversion factors themselves are not exact. Figuring 16d nails at six pounds per 1000 board feet of lumber or .15 cy of mortar per 100 8" block are examples. Recognizing there are many opportunities to make mistakes in the take-off process and several ways to minimize the chance of making them, the above procedure may be most helpful for making the take-off a communicative tool.

Labor estimating. Requisite for estimating labor is a quantity estimate of the work to be done and a decided way to do the work. A labor estimate applies labor rates to given quantities of material. Since material estimates should be within 2% for new work or 5% for rehabilitation work, we should be able to put together a labor estimate that would match anticipated performance. Unfortunately, that is not often the case. Variation in methodology appears to be a primary cause.

Some of the most spirited discussion that took place at CECOS during my stay there, occurred when the Group VIII Advanced Career Course tackled labor estimating. Among the more interesting procedures espoused were:

"Take Walker's figures and multiply by two and a half across the board."

"Use the average column of the Seabee Planner and Estimator's Handbook and divide by 1.25."

"Use the average of the new Mean's Estimator and the average column of the Seabee estimating guide."

"Take the Operations Department estimate and double it."

These schemes apparently worked for the people who used them. However, applying several rules to a given task does not produce the same labor estimate. Results vary by more than 200% for some tasks.

What the methods do have in common, however, is recognition of an experience source and a tailoring process intended to conform the estimate to new job conditions using a labor source which is expected to be different from that of the source.

There are arguments against breaking apart the labor estimating process. First, the entire process is a judgment of the estimator and should be treated as such. Second, since one cannot assign cardinal values to job or human factors, it is of no value to consider them separately.

These arguments are countered by the following: the estimate should be objective and factual. Therefore we should separate the guesswork from an accepted norm in order to improve the quality of the guess through successive trials.

As to the problem of rating job and human factors, one does not have to rate them on a scale from one to ten in order to make them useful.

The simple classification of "less than, equal to, and greater than" is very useful. We can ask, "Does this factor inhibit job

'difference in planning can make project turnovers chaotic...'

'talking a conflict over before the tempo of work causes a polarization of positions can be a real time saver'

performance?" If it doesn't, we've eliminated something. If it does, we can do some guessing knowing where the uncertainty lies.

Estimating source. The information is — or is not — provided by the manual depending upon one's choice of book. If the conditions are given, interpretation of the rate still poses a problem. The number given is really a summary of a collection of distributed data. It is a measure of central tendency, but is it the mean, median or mode? What does the distribution look like?

The answer is we don't know. We must accept the number as representative of some range of values. It's a good starting place for the conditions given.

Each of the items should be written down as an integral collection of conditions. Collectively, they give meaning to the "average" rate. Even when one enjoys the luxury of consulting with the people who will do the work, it should be realized the data is more closely allied to that gained from a manual than that of the job anticipated to be done, except human skills may be already considered.

Job factors. Using yes/no criteria in evaluating job conditions, we state the norm and compare expected conditions with it.

Factor	Norm
Weather	Temperate climate. Temperature fluctuates between 65 and 80 degrees F. Relative humidity is between 25 and 75%. Wind is less than 15 m.p.h. No rain.
Trade Coordination	Crews have no coordination requirement with others on the job. They may move in, do their work and move out without affecting others.
Size of Job	The work site is large enough to accommodate the crew. The men should not be getting in each other's way. Mobilization time is not a significant portion of the work, or has been considered separately.
Complexity	The crew members are not going to have to spend an inordinate amount of time studying the plans on the job to get the job done right.
Materials handling capability	Materials are readily available to the worker without handling. Machines are assigned to moving heavy or bulky items.
Site confinement	There is room to store materials on site. Things do not have to be stacked. There is maneuvering room for equipment.

The beauty of isolating job impediments is threefold. First, we know what does not affect the job. Second, having identified potential trouble areas, we can attempt to minimize their effect through pre-construction conferences. Talking a conflict over before the tempo of work causes a polarization of positions can be a real time saver. Finally, we have a basis for quantifying the effects of impediments. If the temperature is 100 degrees, we can't expect the crew to get much more than 30 minutes work done each hour. Or, if there is no way to avoid interaction between the carpenters and electricians, wait time can be programmed.

Human factors—skill. Variance of worker skills is the most logical explanation for the success of estimating rules mentioned by the CECOS students. Norms are found in the estimating guide; a construction worker who regularly does the work is the basis for the estimate. Seabee skill classifica-

tions are intended to correlate with general skill levels of journeyman, apprentice and helper. Rather than be a measure of the rate at which one could perform work, the levels are more closely akin to responses to the question, "What could he do if his life depended on it?"

This is not unreasonable when one considers a Seabee does several kinds of work within his rating. He is not the specialist one would find in industry. It is a tribute to his motivation that he continually does so well.

For the estimator, there is no present collection of experience that would produce a learning curve for given types of construction work. Here, he should explain his guesswork by stating his assumptions concerning the rate expected initially and his thinking as to how it might accelerate with practice.

Motivation. There is a spectrum of opinion regarding the relationship of an individual's satisfaction to his work performance. This writer holds that lack of motivation should not be considered an impediment to optimal performance when making a labor estimate, but that the estimator should be constantly aware of the motivational consequences of his own work.

When one compares the biographical writings of great leaders to results of psychological research, there is a significant difference. Leaders appear to have treated their seniors, peers and subordinates as unique individuals with different needs. Psychological research attempts to develop a sameness among people in order to prescribe rules for satisfying individual needs on a collective basis.

While there is some merit in many studies, they tend to have a sloppy or loose application of a few fundamental rules of statistics. Among the violations are the following.

Causation implied by correlation. Some researchers have asserted job satisfaction causes superior performance and cite a measured degree of correlation between the two characteristics. It is just as plausible to assert that superior job performance produces job satisfaction. Maybe some third causitive agent produces both.

Significance of the correlation coefficient. Correlation coefficients of .6 are generally accepted as quite significant when summarizing the relationship between two sets of data. One would tend to think that 60% of the observed data supported the hypothesis tested. However, we must square the correlation coefficient to get any meaning from the number itself. The square of the coefficient tells how much of the observed variable is explained by the hypothesis.

Thus a correlation coefficient of .6 means that 36% of the observed behavior is explained by the hypothesis stated. The other 64% is unexplained.

Framework of the study. A relationship between two factors is hypothesized. Actual behavior is compared to the predicted behavior to see if there is a significant difference between the two; significant difference meaning a difference large enough so as to be beyond rational credibility that it could have occurred by chance alone.

This stacks the deck in favor of going along with the hypothesis. The tendency is to retain a hypothesis until there is overwhelming proof to the contrary. The legal analogy of presumption of innocence is descriptive of the problem.

Given the possible wrong outcomes of releasing a guilty person or of punishing an innocent person, society holds the latter to be worse, and encourages error of the first sort as opposed to the second.

Regardless of what the truth may be, the safest perception for the planner-estimator is that he has an opportunity to lower motivation of the whole work force and, if he does, he will screw up the job. It doesn't make much difference which causes the other. Experience tells us it is hard to stay pleased with ill conceived or poorly planned work, and also that well planned work can be a salve to an otherwise angry or frustrated person. It just doesn't make sense to presume lack of motivation will be an impediment to an otherwise well constructed plan.

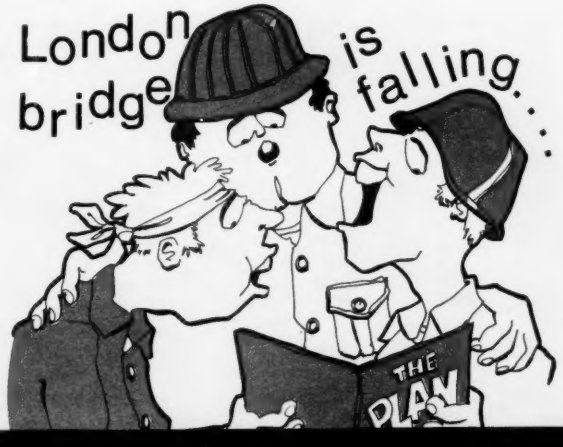
Reassembling the parts. Putting the parts together to make a project network or work plan is not a difficult task. The rules are straightforward. But seldom do the results of two planners look alike. The reason is probably one of education. We learn the technique at a multitude of institutions. To learn, one has to adapt rules of notation: arrows mean one thing; circles, boxes, triangles and dotted lines mean other specific things. Some call the procedure network analysis, others call it CPM, and still others call it precedence diagramming. So we have many people saying, "My way is best because . . ."

The next thing we learn is to place ourselves above the notation, and focus on the usefulness of the technique. We begin to appreciate the pitfalls of myopic concern with the critical path, the uncertainty of material procurement and delivery and how these activities can become more crucial than construction activities, the dynamic nature of the whole process, etc. So we righteously say, "Draw it any way you want."

We need to adopt one rigor, not because it is better than another, but because we want to use the network and resource schedules as communicative tools.

When it comes to Seabee construction projects we could make some money by all singing out of the same songbook. We should attempt to standardize our planning documents to make them communicative tools among Battalions at project turnover. That being done, the project manager should be able to devote more time to the fun part of the construction job, the differences that really matter—those inherent in the construction process. They are the differences responsible for the very real generalization that 20% of the work will cause 80% of the problems.

'make some money by all singing out of the same song book.'



At left is an artist's concept of the F. Edward Hebert Defense Complex. Above is the new Navy travel lodge, and below are family housing units built for Navy enlisted personnel stationed in New Orleans. All are part of the recent construction boom.

New Orleans BOOMS

By LCDR J. E. BUFFINGTON, CEC, USN
Assistant Resident Officer In Charge of Construction
• New Orleans, La.

A naval base for New Orleans was first contemplated in 1849. Then a portion of the present site of the Naval Support Activity was purchased for a navy yard, however, little activity resulted until 1897 when Congress authorized the construction of a large floating drydock, machine shops, a plant for coalling ships, and the other purchase of additional land for support facilities.

These facilities were completed in 1901 and the U.S. Naval Station was established.

The future was to see the Naval Station placed in and out of an active status several times. It was closed in 1911, reopened in 1915 and became dormant again in 1933.

It was reactivated in 1939 and remained is use until 1962.

In 1966, it was declared excess and served only a few units of the Reserves.

In 1972, efforts began to place the Naval Support Activity into full operation, and by 1973, the major construction effort was beginning to take shape in the field.

The first phase of the construction began on the East Bank of the Naval Support Activity. The Mississippi River meanders through NSA, dividing the base into two areas.

An hourly shuttle boat maintains contact between the two banks. During 1919, three 6-story warehouses containing over 1.5 million square feet of storage and costing a total of $7.2 million were built on the East Bank. These warehouses received full use until after WW2. Then they were leased to private concerns, or used by other govermental organizations. But most of the structures remained vacant.

Louisiana Congressman F. Edward Hebert observed that these buildings were structually sound and could be converted into excellent office spaces. Work began in September 1974 and $13 million and ten months later a defense complex named after the congressman was dedicated.

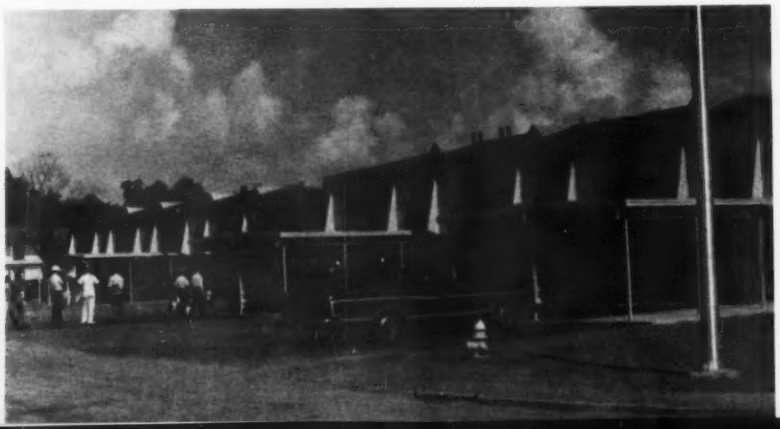
A major problem during restoration was the tight completion deadline. Inception to completion was limited to one year.

Fortunately, the contractor who was awarded the major contract, (with a dozen other contractors receiving minor portions) proceeded to complete the difficult schedule on time. Adding to the construction woes were changes in the function of several of the commands scheduled to occupy the complex resulting in major changes in interior layout of spaces.

More than 120 major change orders were required, with little time for completion. Few contractors could have handled this job in such a superb manner and their accomplishments were recognized at the July 3 dedication ceremony when RADM A.R. Marschall presented the firm, J. A. Jones Construction Co., with the Naval Facilities Engineering Command Certificate of Achievement.

Occupying the new spaces today are the Chief of Naval Reserve; Headquarters of the Fourth Marine Air Wing; the Naval Reserve Personnel Center; the Enlisted Personnel Management Center and the Personnel Management Center which replaces similar functions in Washington, D.C.; San Diego; Norfolk, Va.; and Bainbridge. The Armed Forces Entrance and Exam Station for the Eighth Naval District and varied Army, Air Force, and Marine Units are also housed in the complex. These facilities clearly couldn't be replaced for less than $100 million.

On the West Bank of the Naval Support Activity, new or completed projects include a $20 million hospital; a twenty-two unit travel lodge; a new 211-man BEQ with mess; a new BOQ; rehabilitation and expansion of the navy exchange; a new commissary; 194 new family houses; and projects of a lesser magnitude.



Top to Bottom — Among military projects underway or completed are the Air National Guard hangar, the proposed NAS New Orleans hangar and apron, the Naval Hospital in New Orleans, and the headquarters building for an Air Force Tactical Airlift Group.

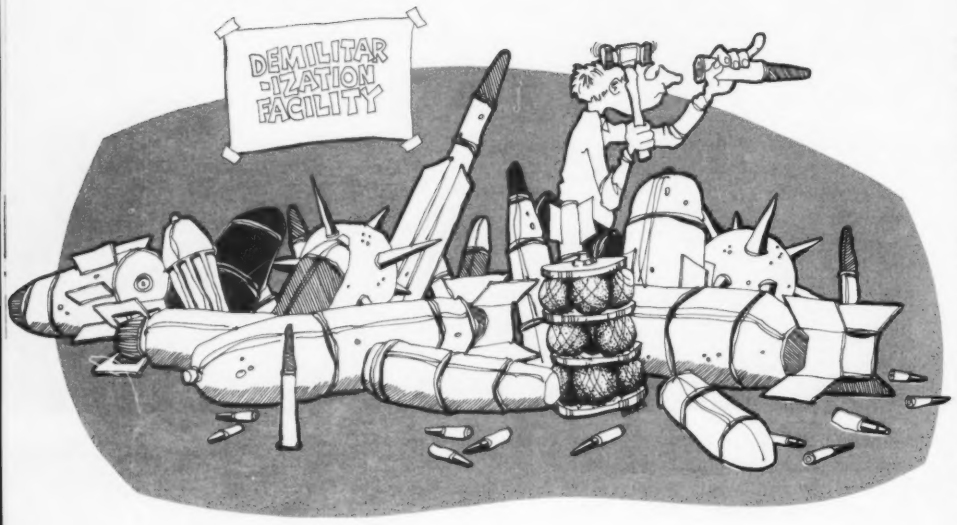
In addition to the Naval Support Activity, New Orleans is the site of a Naval Air Station. It is relatively unique in that is is in joint use with Navy, Army, Air Force, Marines, Air National Guard, and Coast Guard commands. The Naval Air Station is also to become the new home for the Navy's Bureau of Personnel with construction of the mulit-million dollar faciltiy to begin late this winter. It is scheduled to be a two and a half year project with completion planned for October 1978.

Other projects underway at the air station include a $7 million aircraft hangar and aircraft parking ramp for Navy use; 206 units of housing, a major addition to the base dispensary, and additional support facilities. Projects already completed include a new headquarters building and two large shop buildings for the Air Force Reserve, two hangars and parking apron for the Air Force and a new Squadron Operations Building for the Louisiana Air National Guard.

The resident officer in charge of construction also handles contracts in the area for the Air Force and Louisiana Air National Guard and some contracts for the Army, Coast Guard, U.S. Customs Service, NASA (which has a very large facility near New Orleans), and several smaller branches of the Government.

To sum it up, FY74 saw over $6 million work in place, 1975 saw $26 million and 1976 is tracking on $30 million with over 35 active contracts. With the Navy alone having a $106 million program approved and underway, and other military commands in the area building accordingly, there is ample backlog on the horizon to support a strong Civil Engineer Corps contingent for several years to come.

ROICC New Orleans is staffed with 4 officers and 14 civilians and should continue to prove a most challenging and interesting duty station. ROICC/ New Orleans is Captain R. D. Keegan, CEC, USN with ARIOCC's LCDR Jack Buffington, CEC, USN, LT Ray Plyant, CEC, USN, and LTJG Nick Malarchik, CEC, USN.



TAKING THE BANG OUT OF A BOMB

By C. J. STEVENS
Operational Facilities Construction Division, NAVFAC HQ
• Alexandria, Va.

Demilitarization is altering an item so its original military potential is destroyed. The facility being constructed at Hawthorne satisfies this unique requirement for demilitarizing conventional navy ammunition on a major scale and employs the latest industrial processes, safety features, pollution abatement considerations, and criteria for fuel consuming projects.

There are three basic categories of ammunition needing demilitarization: obsolete according to recent standards, unserviceable due to prolonged storage, and rejects from production quality control. Demilitarization is required to dispose of ammunition in these categories in an efficient, safe and ecologically acceptable manner.

At the time the project was developed by ORDSYSCOM (now SEASYSCOM) in the FY73 MILCON Program, dumping at sea, open burning and detonation had been banned by the Environmental Protection Agency. The construction project was justified for these reasons, plus the probability of an economic return from re-use or sale of recovered materials.

The project site occupies about 150 acres and is located some 130 miles southeast of Reno.

The original concept proposed construction of three major processing centers; for small caliber, medium caliber and large caliber conventional ammunition. All operations for each caliber would have been carried out in the respective processing center.

As the project began to develop, a study by the Naval Ammunition Production Engineering Center (NAPEC) at NWSC Crane, Indiana, showed construction of a number of buildings for specific functions, each of which could handle ammunition of any caliber, would be more efficient.

Accordingly, process centers include units for unloading, preparation, mechanical removal, large cells, smokeless powder accumulations, steamout/washout, bulk incinerators, refining and decontamination. Moving most material between major buildings will be by a wire guided, driverless tractor train; the wire being buried in the roads.

Supporting facilities include five earth-covered metal arch magazines, a boiler plant and a technical support building.

The "demil" facility can handle all conventional Navy ammunition from .30 caliber through 16 inch projectiles, all bombs, mines and depth charges up to 3,000 lbs. net explosive weight, all Navy cluster weapons, and many rocket warheads, grenades, demolition materials and pyrotechnics.

The processing route for an eight inch projectile will be traced to illustrate the flow through various buildings. After being defused in the preparation building, the projectile goes to the mechanical removal building where the explosive is removed. If the explosive is good, it is taken to the refining building for reuse; if the explosive is contaminated, it moves to the incinerator building for disposal.

The metal goes to the decontamination building for processing incident to salvage or scrap. Sale of scrap metal, propellants and explosives is expected to earn about $6,300,000 a year over the first three years of operation.

Special consideration was given to pollution abatement in this facility. Any explosive materials contained in washdown waters from the processing buildings is removed by chemical treatment and filtration. The resulting sludge is burned in the incinerator building and the clean water is re-used in process buildings. Evaporation ponds are provided to care for possible overloads or a breakdown.

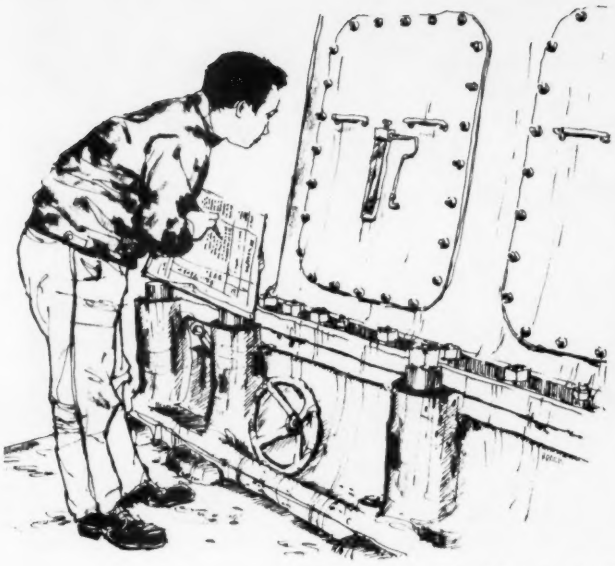
The boiler plant, with three 50 mega BTU/hr boilers, was originally designed to burn oil but energy conservation required redesign to burn coal with oil as a standby fuel.

After enactment of the FY73 Authorization Act, but before the start of construction, the EPA rescinded its ban on ocean dumping and now permits it, subject to restrictions. This caused re-evaluation of the project which determined it was still in the economic interests of the government to demilitarize ammunition rather than dump it at sea.

Two construction contracts totaling $16 million have been awarded to date; future construction contracts are estimated at $20 million. NAVFAC is also responsible for the design, procurement and installation of all operating/process equipment.

The Hawthorne "demil" facility is one of the largest MILCON projects underway. It has involved and will involve a large amount of engineering, research and design, and will result in a facility that will perform a function previously unknown on such a large scale.

In conclusion, Nevada will soon have two rather unique facilities: the widely known "demarital" facility at Reno where one partner may be divorced from the other and the newer "demilitar" facility where an explosive is "divorced" from its container.



Skilled Technicians

Our Next Shortage?

By DONALD K. JOHNSON, P.E.
Facilities Maintenance Branch
NAVFAC HQ

• Alexandria, Va.

During a trip to CECOS, the vice commander of NAVFAC, Rear Admiral Donald G. Iselin, CEC, USN, held an informal question and answer session with officers attending the newly established refresher course.

One discussion concerning maintenance management and training is considered to be of interest to all public works personnel; accordingly, several of the questions and comments relating to the use and training of public works personnel are presented here for general information.

Q. *Is there a continuing trend to replace in-house public works forces with contracted personnel?*

A. At all public works activities, OPNAV has directed that 70% of janitorial services and 60% of refuse collection will be contracted. At present, 62% of janitorial services and 37% of refuse collection is accomplished by contract at public works activities. The trend is upward and it is expected that the OPNAV goals will soon be reached.

PWCs have been directed to contract 15% of their specific job orders in addition to the OPNAV contract goals set for janitorial services and refuse collection.

There are and will be many new and complex monitoring and control systems for utility plants and systems. These controls use the latest state-of-the-art solid state electronic components in conjunction with a multitude of different sensors. Generally maintenance of these new systems will be beyond the capabilities of most blue collar workers. As these systems proliferate, it will be necessary to establish contracts with the system supplier in order to maintain the systems in proper working order.

It is believed that, in the long run, it will be necessary to develop electronic technicians in the PW departments to trouble shoot these systems on a cost effective basis. This will be a long term solution, but one we must face. If not, the cost of maintenance will continue to rise, and it is doubtful the contractors will be able to provide the response we desire.

Q. *A lack of literature and training in budgeting for public works is clearly evident. Is anything being done in this area? What do we have? What are we working on?*

A. CECOS instructors are updated on the currency of Navywide budget procedures on an informal basis when they visit NAVFAC HQ.

• Basic material regarding OP-44 RPMA management improvements has been provided informally to CECOS. The basic problem of each claimant being somewhat autonomous presents a problem in establishing standard budgetary practices and techniques.

• As the OP-44 RPMA management improvement plans unfold those techniques should be stressed in course materials for CECOS and NTTC Norfolk.

Q. *Please speak of the high average age of PW personnel and zero input of new apprentices. Are we letting a big problem sneak up on us?*

A. The following facts apply: by end of FY77 almost 25% of PW personnel are expected to be lost through retirement.

By contrast, just over 6% of PW personnel are apprentices/trainees; 85% are journeymen; 4.8% are intermediate mechanics and 4.1% are helper/sub-helpers.

One area which PW officers should emphasize is operator training of their personnel. Various technical courses are available. In addition, it is up to the user or PWO to get his money's worth on new construction — this means adequate training and check-out on new systems by manufacturers and contractors. The PWO must emphasize this with the ROICC and insure that such provisions are included in the contract specifications initially. When possible, video tape cassettes of factory representative instructions should be requested. The same applies to operating manuals, as-builts, and manufacturers test and performance data.

There is a strong need to provide PW personnel with adequate training and literature. This will be done to the extent of resources availability. Funds are being requested to update MO manuals and develop coordinated training material.

NAVFAC has directed NTTC to conduct a survey of wage board employee development requirements. The results were published in NAVFACNOTE 12410 dated 20 August 1975.

• 8% of reported personnel lacked knowledge of the basic rudiments of their occupation.

• 19% required updating of skills for adequate performance in their occupation.

• 26% are in need of advanced training to keep pace with changes in technology.

Public Works personnel reductions between FY69 and FY73 appeared to "bottom out" in FY74. Real property maintenance emphasis by CNO together with increased funding has resulted in an increase in personnel above the FY74 level for FY75.

Activities and public works personnel must submit formal requests for training, instructions, and/or guidance. Documented requests are necessary to promulgate existing programs, justify new training courses, and develop or update operating instructions and maintenance publications.

Flood — Skagit River inundated many towns.

Spared — Seabee-built dike saved Mount Vernon.

Seabees Save A City

by LCDR R. A. WOEHLER, USNR-R

• Mount Vernon, Wash.

When Seabees from CBU-417 at Whidbey Naval Air Station were asked to fight the worst flood in Western Washington history last December they didn't think they would also be saving their own water supply system.

The Seabees were called Dec. 3 by the Army Corps of Engineers to help Mount Vernon, a town of 10,000, in danger of being flooded by the Skagit River.

The disaster, called a 100-year flood by the Corps of Engineers, caused more than $50 million in damages, put 50,000 acres under water and killed 5,000 cattle. Luckily, no people were lost. Mount Vernon, 27 miles east of NAS Whidbey, was one of the areas hardest hit by the flood.

The Skagit River at Mount Vernon reached nearly eight feet above flood stage and several who had lived through the 1951 flood, then called the worst in history, said this one surpassed it.

The Seabees began putting up a sand bag dike to protect the Mount Vernon downtown area. Disaster control at NAS Whidbey sent a communications team which set up headquarters in Mount Vernon's Teamsters Hall. A mess team set up a field kitchen in a county garage about two blocks from the river.

When the Seabees arrived the townspeople and volunteers were a confused group, a Corps of Engineers official said. "The Navy's presence drew the townspeople together and got volunteers moving to build the dike," said Lt. Col. John Terpstra, deputy district engineer for the Corps' Seattle office.

He credited the Seabees with being the catalyst for building the dike. "Mount Vernon should give the Navy a lot of credit," he said.

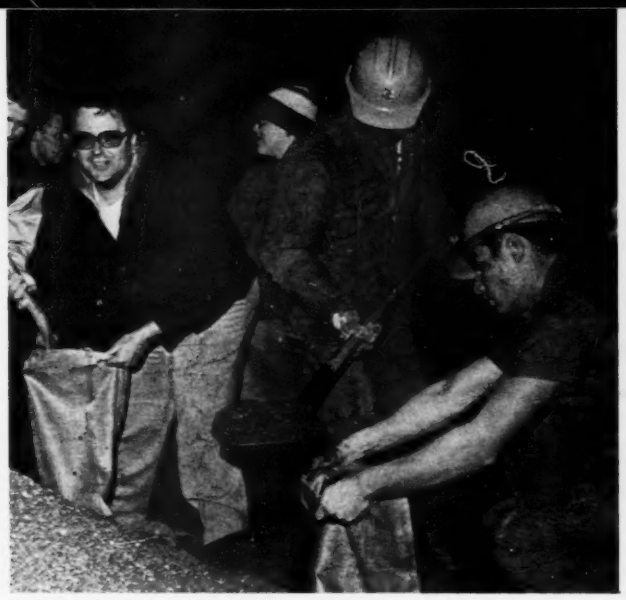
Seabees, in their green hard hats, attracted the attention of youngsters who joined them filling and stacking sand bags. "The youngsters worked longer with us than the adults," one Seabee said. "Once we got started the people came out by the scores to help," Ltjg Guy Blanton, OinC of CBU-417 added. "Those who weren't helping wanted to supply the Seabees with hot food and coffee."

Blanton's most difficult job was keeping his unit together. "There were a lot of people giving orders and wanting to split us up, but I felt we were most effective as a unit," he said.

Seabees worked all through Dec.3, securing at 5 a.m. Dec. 4. They filled and put down 30,000 sand bags to help build a dike three-feet-high that ran for five blocks between the river and Mount Vernon's downtown area. "The Navy was the leader here," said Brad Luton, Corps of Engineers official in charge of the Mount Vernon effort.

He said the Seabees showed the townspeople how to fill sand bags and also how to build a dike. "The natural reaction of someone building a dike for

Bagging It — Seabees worked round the clock (above) to save Mount Vernon and a nearby power plant. Their sandbag dike prevented floodwaters reaching the downtown area of the city (below).



Help — Schoolkids and citizens of Mount Vernon pitched in, filling sandbags after the Seabees' work spurred them to action.

Drenched — Hardhatted Seabees worked in a driving rain to build a dike around a power plant. The plant supplied electricity to pump water for NAS Whidbey. Below, a tired Seabee rests.

the first time is to stack the sand bags to end to get height, but you need to lay them flat so the dike will keep out water," Luton said.

He said Mount Vernon was potentially the worst spot for damage in the entire Pacific Northwest because of valuable real estate so close to the river.

The Seabees were relieved by a 32-man crew from the base headed by LT Duke Smith early Dec. 4. By 5 p.m. that day Blanton and his men, rested, refreshed and fed, were back in Mount Vernon ready to challenge the river again. The Skagit had risen several inches since that morning and the crest wasn't expected until about 10 p.m.

A report then reached authorities

the power supply for a water treatment plant outside town was in serious danger and the river was seeping through a dike already built there.

After two days building sand bag dikes to prevent flooding in the downtown area, Seabees were called to the plant about two miles outside town. Blanton explained the problem.

"The river was threatening to flood the power supply to the water treatment plant and if it went out, the water plant would also be knocked out," he said. Charles Davenport, city manager for nearby Anacortes, said the water treatment plant serves 23,000 people in Anacortes, La Conner, Oak Harber and at Whidbey Island Naval Air Station. If the power supply were lost the three towns and the Navy base would be without treated water in an area that already had more than its share of scares about contaminated water.

Blanton, surveying the situation in a driving rain storm, saw it was more than his 54 men could handle in the time available. The raging Skagit river was rising.

LT Smith, whose crew was preparing to leave after spending most of the day fighting the Mount Vernon flood, was asked to bring his men to the treatment plant. Blanton said the problem of building a dike was complicated by the condition of the ground around the plant: the flood had turned the fertile farmland into a spongy tundra.

"It was like walking across a water bed, with the ground giving away with each step," a Navy man said.

Because of seepage and pressure from the river, water was boiling up inside the dike that protected the treatment plant and threatened to inundate the power supply. A four-foot dike was constructed around the trouble spot to raise the level of the water and put back pressure on the river.

Outside the dike, sand bags were laid on the spongy ground to stabilize it and prevent further blistering of the soil.

The ground was so unstable, dump trucks couldn't drive to the dike the Seabees were building.

Blanton called Whidbey Island and asked for volunteers and material. Two hundred more men were sent to work with the Seabees. Materials included wheel barrows from Mount Vernon and wooden planking from the Seabee unit. The planking was needed to build a catwalk for the wheel barrows.

A bus load of volunteers from town came to help, but were told by the Corps of Engineers they could do more good in town filling sand bags.

Townspeople filled sand bags which were put on a Seabee lowboy and trucked to the treatment plant. The sand bags were taken across the catwalk about 200 feet to the dike. Soon there was a system of plank walks across the ground with wheel barrows coming and going.

"The fatigue didn't start to hit until around 2:30 a.m." a volunteer said. Townspeople brought food and hot coffee to the scene.

When the dike was finished at 3:30 a.m. Dec. 5, the river had started to recede, the danger had passed and the plant was saved.

As the dog-tired sailors climbed on busses to return to the base, city and county leaders were already thinking of ways to say thanks.

"The city of Mount Vernon is grateful to the Navy. It was a wonderful effort," said Mayor Jack Miller.

Taming Aircraft NOISE

By EDWARD FERENCE
Head, Structural Engineering Branch, NAVFAC HQ

• Alexandria, Va.

In the Summer 1974 issue of the *Navy Civil Engineer*, R. B. Foster of Southern Division wrote of the aircraft acoustical enclosure being developed for Miramar Naval Air Station. This article provides additional background information on the Navy's noise control program and an update on the system being developed for Miramar.

In compliance with the Noise Pollution Control Act of 1972 and the Occupational Health and Safety Act (OSHA), the Navy established a program for noise abatement at naval air stations. Part of the program is directed at suppression of aircraft engine noise in ground run-up operations. Noise pollution is generated by testing engines which have been overhauled or have undergone maintenance both before and after installation in the airframe.

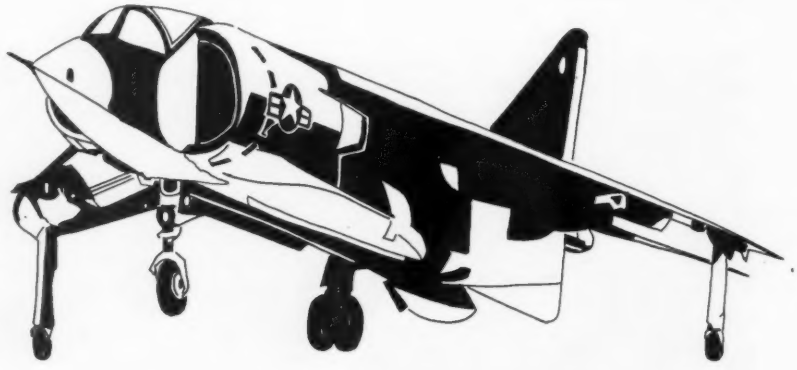
During much of the testing, engines are operated at high power, producing extremely high noise levels for up to two hours for each test. Noise levels during maximum power operations violate current laws and regulations affecting the military and civilian communities in and around Navy and Marine Corps Air Stations.

For example, an F-14 aircraft, the Navy's newest fighter, produces a noise level of 124 dba 250 ft. from the aircraft and 90 dba one mile from the aircraft. OSHA standards allow a maximum of three and one half minutes and eight hours a day for individuals exposed to 124 dba and 90 dba, respectively.

OSHA standards, however, are only part of the problem. Civilian community tolerance to jet engine noise, particularly at night, is far below levels which can cause hearing loss. Noise levels which interfere with an individual's ability to communicate, sleep, and enjoy outdoor living at Navy and Marine Corps Air Stations will no longer be tolerated.

The Navy's program for noise abatement is to test both installed and uninstalled engines in an acoustical enclosure which reduces the noise level to 85 dba in a 500 foot diameter circle around the enclosure. As indicated in Mr. Foster's article, we developed the design of a dry noise suppressor similar to one used in Europe.

In the United States, both military and commercial exhaust noise suppressors for afterburning engines use water for cooling the exhaust to temperatures compatible with the construction materials including acoustical baffles and the stack itself. To achieve required cooling, flow rates of about 1000 gallons a minute are common.



Normally, electric pumps are used to achieve required flow and pressure. The exhaust stack emission is water saturated and produces a highly visible wet plume which "falls out" with dirty wet particulates near the stack.

In response to recent efforts to eliminate the wet exhaust plume, reduce electrical energy consumption and avoid unnecessary consumption of water, NAVFACHQ sought to develop a noise suppression system which would be more effective in achieving these goals. An investigation in Europe by a team of contractor and Navy personnel revealed effective systems are in use there which do not use water for cooling, and providing generally lower operating and maintenance costs than a wet system.

The joint team evaluated European systems and found the most desirable from the Navy's standpoint was an air-cooled acoustically treated tube terminating in an acoustically lined deflector. Noise reduction through the tube is accomplished by means of sound wave defraction through a perforated liner by the temperature and velocity gradients in the tube.

Though some felt that there was sufficient empirical data and experience to design an acoustical enclosure for NAS Miramar, we felt more information was needed to develop optimum designs for the wide range of Navy aircraft. Ideally, a test program on a full-scale facility would develop the most reliable data.

However, the cost of such a full-scale program and its disruption of fleet operations made it prohibitive. The use of a 1/15 scale model of the system, along with full-scale verification, was con-

NOISE *(Continued)*

sidered a second best choice for securing required data.

The model study effort was funded and has now been completed by Fluidyne Engineering Corporation and their acoustical subcontractor, Bolt, Beranek, and Newman. The model study generally confirmed predicted aerodynamic and acoustical performance upon which the Miramar design was based. Results of the study will allow us to design future facilities with a rational basis for configuration and selection of sizes and materials.

Upon completion of the full-scale NAS Miramar facility this summer, empirical data used in the design will be tested and correlated with results of the model study. Evaluation of the results of both the model and full-scale tests will allow us to optimize the design of acoustical enclosures included in future military construction programs.

Paralleling NAVFAC's development of a dry noise suppression system for military construction programs, NAVAIRSYSCOM has been pursuing development of a system for carrier and demountable applications. The system is the Coanda/Refraction Noise Suppressor being developed by the Wichita Division of the Boeing Company. After completing a number of 1/6 scale model studies of the Coanda, Boeing is building a full-scale suppressor.

The system uses the Coanda effect to deflect the jet exhaust stream upward along a curved path. Using the principle of sound defraction, acoustical baffles are located outside the path of the gas stream allowing use of a dry system for reducing the noise level to 90 dba in a 500 foot diameter circle around the suppressor.

NAVFAC and NAVAIR may join in a mutual effort to optimize the Coanda system for possible military construction application. This would be done through the use of an acoustical model such as the type used for the "European" system.

While progress has been made in the suppression of noise from the testing of jet aircraft, improvements are being sought. The Navy is vigorously pursuing the problem of noise pollution with the objective of providing a better environment for both Navy personnel and the civilian community with the least cost to the taxpayer.

SEISMIC RESISTANCE

By JOHN N. AGNOS
Office of Assistant Commander for Engineering and Design, NAVFAC HQ

• Alexandria, Va.

When facilities (buildings and other structures) are designed for Navy use, the structural design engineer provides adequate structural reinforcement for the facilities to resist earthquake forces.

While buildings and other structures are designed to resist damage from earthquakes, the non-structural systems (electrical-mechanical) in a building or structure seldom are designed to resist damage from earthquake forces. Therefore, when an earthquake occurs, even though the structure itself may not be damaged, chances are the facility will not be operational because of damage to these non-structural systems.

There are many facilities in the naval shore establishment that have non-structural systems with inadequate seismic resistant supports. Therefore, these facilities are subject to damage and are also a threat to personnel safety during an earthquake.

To reduce these risks, the Naval Facilities Engineering Command Headquarters, Office of the Assistant Commander for Engineering & Design, initiated an Engineering Investigation contract with the A&E firm of Skilling, Helle, Christiansen, and Robertson, consulting engineers.

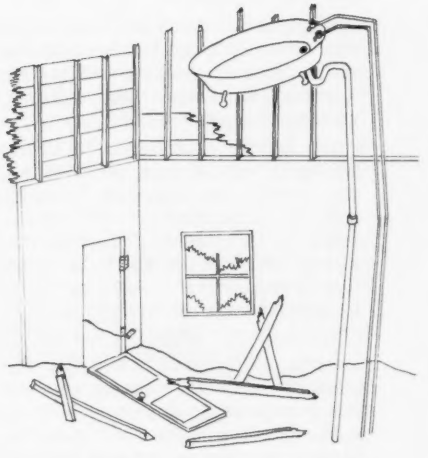
This contract was for the development of criteria for seismic resistance of existing electrical and mechanical equipment and utilities based on a study, evaluation and selection of the best known earthquake resistant methods.

The study is complete and NAVFAC P-355.1, "Seismic Evaluation of Supports for Existing Electrical-Mechanical Equipment and Utilities," has been published and distributed to Engineering Field Divisions and interested commands throughout the Navy.

NAVFAC P-355.1 furnishes design criteria to improve the seismic resistance of existing electrical and mechanical supports and utility systems in earthquake zones one through four. It provides design examples of typical representative equipment support and restraint systems, connection details, and cost estimates to improve existing facilities.

NAVFAC P-355.1 is divided in five sections. Section one describes the purpose, scope, design criteria and basis for the publication. Section two pertains to electrical equipment and includes tables and illustrations used to determine restraints needed to improve the seismic resistance of electrical equipment and hardware — such as transformers on grade, pier or pole, portable substations and portable switchgear; stationary switchgear; batteries at emergency and control stations; emergency generators; lighting systems (interior and outdoors); and electrical distribution systems.

Section three pertains to mechanical equipment. Illustrations are included for use in determining the required restraints for mechanical equipment such as chillers, unit heaters, vertical water tanks, fan units, cooling towers, chiller-absorption cold generators,



package boilers, central station air handling units, supply fans, and interior and exterior piping systems (gas, steam, air) etc.

Section four includes the civil engineering category items and primarily describes earthquake restraint improvements for exterior fresh water, salt water, and sanitary and storm sewer distribution systems.

Section five deals with restraints for improvements to elevators and associated systems.

It is anticipated an Office of Secretary of Defense Directive will soon be issued which will require seismic protection to be provided on electrical and mechanical systems of some existing facilities.

So What Else Is New?

Energy Cost Is Rising

By JOHN N. WILLIAMS
Energy Program Branch
NAVFAC HQ
• Alexandria, Va.

Meaningful estimates of future energy costs for the operation of the Navy's shorebased utility systems are extremely difficult since these costs are directly affected by constantly changing variables.

Traditional cost trends are only partially helpful in determining what the price of any particular fuel will be in one, five, or ten years. The inability to predict prices concerns future actions which congress and the administration will take on the rates for domestic crude oil, import taxes on foreign oil, the deregulation of natural gas and other measures to stimulate supplementary energy development.

Supply and demand does continue to affect price, but the factors regulating supply and demand complicate the economic calculations that normally predict future prices.

The Middle East war of 1973, the subsequent oil embargo, the Organization of Petroleum Exporting Countries, crude oil price increases, and nationalization of petroleum facilities in various countries are but some of the type of factors that provide an unpredictable influence on the price of energy.

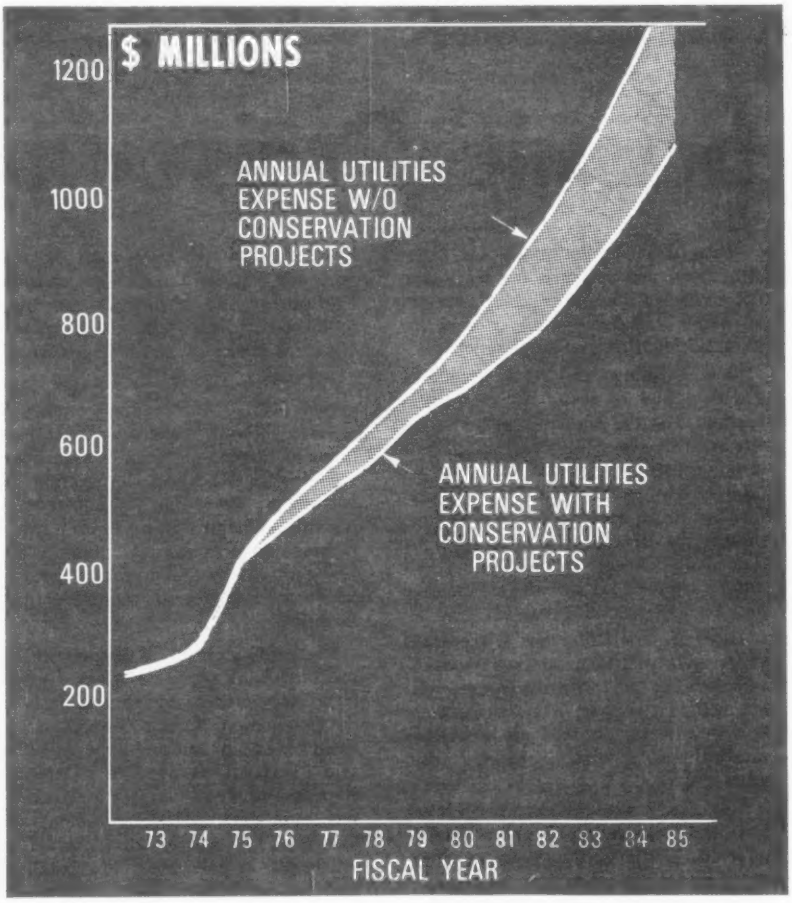
Nevertheless, planning for energy conservation projects, alternative fuel selection, and other energy resource management functions must rely on projected energy costs several years in advance in order to achieve balanced budgets, cost effective projects, and optimum energy decisions.

Utilities Operation Costs

Approximately $225 million in FY73 was spent Navy-wide for purchased and produced shore-based utilities. This cost may quadruple in the next ten years to *a shocking one billion dollars.* Energy conservation efforts have already kept the growth of utilities down from the historical *9.5% increase* experienced each year in the past 20 years.

Additional savings will begin to accrue from military construction projects specifically designed to conserve energy in existing facilities. When funded and completed, these projects will shave off $200 million each year in operating costs when otherwise the annual cost of utilities would approach $1 billion. This will require a continued annual investment of between $50 and $100 million for the next several years in "high payback" energy conservation projects. These projects promise to be an important contribution to the strength of Navy fleet support.

Since utility bills must be paid first from the operation and maintenance budget, such energy savings are real hard-dollar savings which can be diverted to the realization of mission-related operational goals.



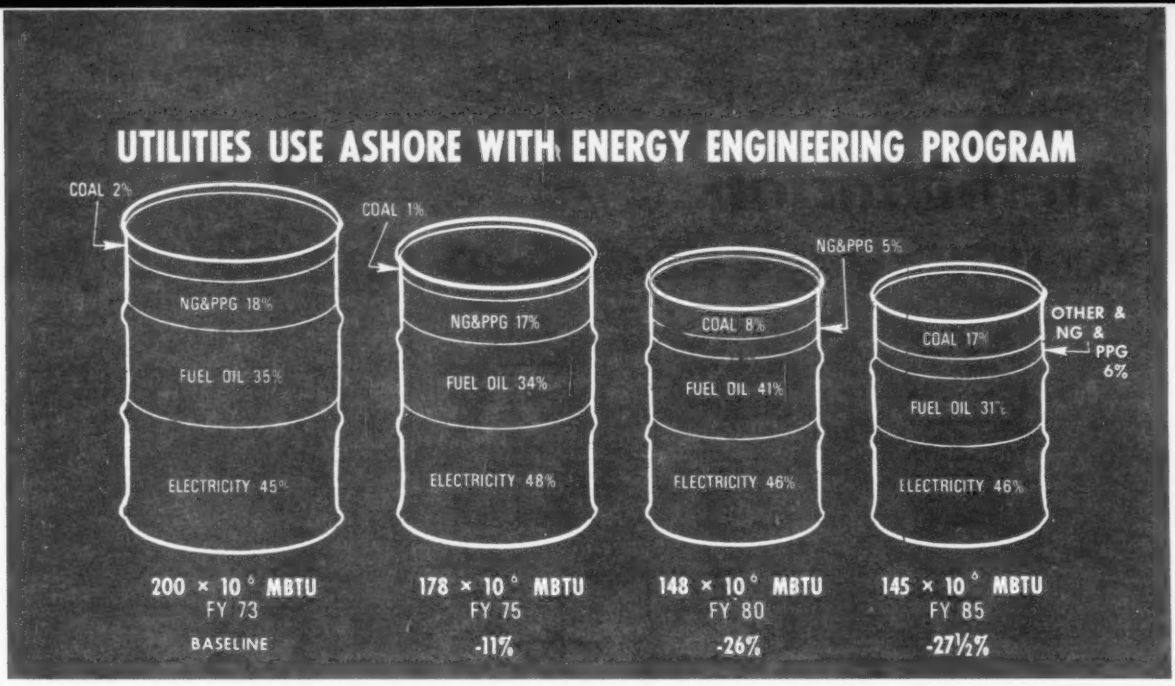
Energy Mix Projection

Since FY73, the major types of energy used throughout the Navy have already changed in their percentage of use and represent the actual energy conservation realized from FY73 to FY75, combined with a reduction goal through FY80.

Boiler conversions to coal will increase the percentage of coal by FY85 with a corresponding percentage decrease in oil and natural gas. It's almost a sure bet that only Navy Family Housing units plus a few isolated natural gas stoves and process furnaces will be using natural gas by FY80.

Nuclear, solar, refuse derived fuel, geothermal, and other sources of energy are predicted to be implemented in significant percentages from 1985 through 1995. Prior to FY85 these fuel sources will necessarily be a small part of the 6% shown in the FY85 "barrel," unless current research and development quickly improve their cost effectiveness in replacing the Navy's large gas and oil steam generating installations.

Crucial to planning for the implementation of energy sources other than



the traditional gas and oil is the accurate forecasting of energy prices. A wide range of energy prices will continue to exist at the Navy's geographically diverse locations. One Naval activity may pay considerably more for energy than another activity because of the following variables:

- Fuel source used in utility generation varies widely viz, hydroelectric in the Northwest compared to imported oil in the Northeast.
- Proximity to the source of the energy can vary the transportation costs.
- Quality of fuel required (sulfur content, etc.) to comply with environmental limits is a major price determinate.
- Variances in the number of heating degree-days.

Navywide costs from one year to the next therefore cannot be used as absolute values to project costs at any individual activity. But intelligent estimates based on the best information available can and must be made.

Forecasting Unit Costs of Energy

Fuel Oil. The average price of fuel oil has surpassed coal when compared by the common denominator of millions of British Thermal Units (MBTU). The steep rise in fuel oil prices in FY74 has now slowed somewhat, but is expected to remain more expensive than coal. Exploration for oil is being conducted in such remote areas of the world that production costs should further escalate the price of the delivered oil by more than $1 per MBTU over the price of delivered coal by FY80.

Coal. The first half of FY76 has shown a reduction in the unit price of coal. This is expected to be only a temporary decline as the cost of new mines and safety improvements in existing mines becomes an increasing portion of the cost of coal. Even with stringent environmental restrictions on such aspects as stripmining, and stack gas emissions, coal is expected to become the most economic fuel for major naval boiler installations. There are other cost considerations with coal, of course, because of its high handling costs, ash removal, and the expensive emission control equipment investment and higher operational costs.

Natural Gas. Although there is still regulation of natural gas prices, administratively rather than acquiescing to the natural action of supply and demand, natural gas is considered equal in price to fuel oil for planning purposes in the Energy Conservation Investment Program projects. This is due to natural gas being phased out eventually as a boiler fuel and the inevitability that as the reserves of natural gas in the United States decline, the price is forcasted to exceed both oil and coal.

Electricity. Historically, the equivalent unit energy cost of electrical energy has been greater than the cost of any of primary fuels used in the generation of electricity or in the provision of heat. This ratio will continue to exist, and although fuel oil has overtaken the equivalent cost of electricity, this should only be a temporary occurrence. Because of the built-in delay in electric utility companies obtaining rate adjustments, the electric cost increase usually follow fuel price increases. At many large installations electricity is not purchased "delivered" at the end use location but must be transformed and distributed over Navy equipment. This causes the purchased unit cost to be misinterpreted as more economical than its final delivered cost.

Some of the factors which will contribute to electrical energy's cost increases, but which make accurate crystal-balling difficult are: electrical industry shift from oil and gas to coal and nuclear; environmental constraints and additional costs associated with both coal and nuclear; availability of new capital required for more expensive plants to meet both increased electric requirements from the economy's shift from oil and gas to electricity and the pollution abatement equipment necessary to operate them; and the extent of federal support or regulation of the electric industry. Regardless of the unpredictables, a reasonable estimate of future energy costs is necessary for responsible management.

The economic curves shown on the preceding page, developed on the basis of conservative assumptions such as limited primary energy cost increases, stable international and national energy policies, and continued industrial expansion, are believed to be useful for long range planning. Local conditions and constraints, will of course, modify this data for each individual activity but the relative trends should be similar.

The role of the Naval Facilities Engineering Command in energy conservation is an essential part of the Navy's overall operating program. New emphasis on conservation is apparent in all NAVFAC's planning, research, design, construction, operation and maintenance of facilities. The need for such emphasis is apparent when considering the alternate budget impact of energy costs if conservation goals are not met.

An invitation to young graduate engineers to join th

It's your life. Lead it.
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ILLUSTRATION BY GORDON LANGE, CEL

...e professionals of the U.S. Navy

CIVIL ENGINEER CORPS

Ensign Ernest R. Hunter (BSEE, Texas A&M '72) discusses data information system with an employee at the Naval Weapons Support Center, Crane, Ind.

LTJG Grant W. Peterson (BSE, UCLA '73) and LTJG Ronald P. DeTroye (BSEE, Wis., '73) at the Naval School, Civil Engineer Corps Officers, Port Hueneme, Calif.

Ensign Michaela K. Tierney (BA-Arch, UC-Berkeley '74) inspects master plan with fellow architect at the Naval Torpedo Station, Keyport, Wash.

Construction and maintenance of the Navy's shore and support installations is just one of the responsibilities of the engineer managers of the Navy's Civil Engineer Corps. And qualification is not limited to the civil engineering discipline, as the Corps requires graduate engineers of mechanical, chemical, electrical, industrial and construction disciplines and architecture too! As a commissioned officer of the U.S. Navy the young engineer is offered greater opportunity to develop quickly a professional career with the added potentialities of an exciting overseas assignment, professional registration and graduate studies! The young officer may be assigned to construction contract administration, public works management or with a Naval Mobile Construction Battalion, the historic Seabees, plus many individual and unique positions.

Engineering students and counselors are invited to explore the multi-faceted world of the Navy's Civil Engineer Corps by contacting their local Navy Recruiter for specific details. An informal visit with a Civil Engineer Corps officer to discuss the personal and professional benefits of a Navy career can be arranged by the same Navy recruiter or by calling or writing the Naval Facilities Engineering Command, (ATTN Code 09MA1), 200 Stovall Street, Alexandria, Va., 22332 Telephone: (202) 695-3635.

Call toll-free 800-841-8000 now if you desire instant information from the Naval Recruiting Command. If you're a good student, and want to be a better engineer, the chances are you'll do best by investigating the Civil Engineer Corps of the U.S. Navy.

GETTING IT DONE!

By CDR WILLIAM R. LEDDER, CEC, USN
Emergency Construction Officer,
Office of the Assistant Commander
For Military Construction
Programming, NAVFAC HQ

• Alexandria, Va.

Have you ever had a desperate need to get something constructed but neither you nor your major claimant had the authority to provide the funds or approval?

Well, perhaps *Urgent Minor Construction* is a place to look to get the job done. Title 10 US Code 2674 as implemented by the Navy in Paragraph 2104 of the Facilities Project Manual (OPNAVINST 11010.20C) provides for constructing urgently required or economically justifiable facilities not exceeding $400,000 in funded cost.

Your key to success in obtaining approval in this procedure is closely attached to those two phrases *"urgently required"* or *"economically justifiable."*

Let's look at *"economically justifiable"* first, as this is the most effective way to obtain funds and approval. If you have a facilities requirement costing under $400,000 which will generate sufficient savings to *amortize the project cost in less than three years* and give you a payback in hard dollars, you are on your way. By hard dollars is meant actual out-of-pocket costs saved by reducing civilian ceiling, reducing O&MN or RDT&E costs, saving utilities expenditures, etc.

Here are a few recent examples to consider. One station consolidated the functions being performed in 28 WW2 wood barracks buildings into 10 existing permanent and semi-permanent buildings generating direct savings in utilities and O&MN costs.

Another activity provided a fueling station in a remote landing field used for training thus eliminating the need to fly back to the main base for fuel. The savings were in fuel and other operational costs. Note that the wear and tear and depreciation on the aircraft could not be considered as these are not hard dollar savings.

Several stations are working on economic justifications to save utilities and fuel costs by various energy conservation techniques. During the past three years, the Navy has obtained approval to construct over $8 million in facilities utilizing economic payback as the basic justification.

Now, let's look at *"urgent construction."* There are several important key items in obtaining approval in this area. If the answer to the following questions is yes, you have a good chance of success:

• Was the requirement unanticipated? i.e., some new task or unanticipated function has been assigned to your activity, or a new breakthrough has occured in the R & D area which urgently requires facilities to implement.

• Will waiting for the next regular military construction program produce unacceptable and highly unfavorable impacts?

• Will there be a direct adverse operational effect if the facilities are not provided? Note: Morale and welfare items are *not normally* considered operational in nature.

• Is there an excess in existing facilities which could be used to fulfill the need?

• Can we construct a facility which meets existing criteria and fulfills the entire requirement within the $400,000 limit?

Success in obtaining funding and construction approval in these areas has been most successful attesting to the fact that if you have a problem there may be a way to solve it. Over the past few years, there has been an average of 80 projects approved in the urgent minor program accounting for over $15 million of facilities construction.

If you have any requirements which seem to qualify under the urgent or economic justifications, but you require some help, you can contact the Emergency Construction Office in COMNAVFACENGCOMHQ, Autovon 221-8601/Commercial 202 325-8601. The office is there to help you get your job done but the only way they have of knowing your problem is your call.

Civilians May Now Attend Navy Postgraduate School

• Monterey, Ca.

In a reversal of a 66-year tradition, Department of Defense (DOD) civilian employees may now attend the Naval Postgraduate School (NPS).

The decision was made in a recent ruling by the general counsel of the DOD. Since 1909, when the school was founded, the student body has consisted almost exclusively of military officers.

Eligible under the new ruling is any DOD civilian employee who meets NPS academic requirements for the program in which he or she is interested, and whose employing agency is willing to act as sponsor. Minimum qualification is an acredited baccalaureate degree with necessary preparation for the proposed program of study.

Also permitted by the ruling will be on or off campus presentation of NPS continuing education courses to civilian groups at the request of a DOD sponsor.

The Naval Postgraduate School grants master's and doctoral degrees in a variety of technical, scientific and management fields. Further information on requirements and programs may be obtained from Dr. Brooks Lockhart, NPS dean of curricula (address Superintendent, Naval Postgraduate School, Code 022, Monterey, California 93940).

Protection And Maintenance

By MARIAN E. DiGIAMARINO
Realty Specialist
Real Estate Division
Northern Division, NAVFAC

• Philadelphia, Pa.

The energy crisis and the Department of Defense Shore Establishment Realignment (SER) Program have greatly affected the New England states, especially the State of Rhode Island. To help that state, the Secretary of the Navy established guidelines for the interim use of excess Navy properties in Newport and the Quonset Point/Davisville complex.

As a result, a new form of agreement, the Protection and Maintenance (P&M) Agreement, was devised by the Northern Division.

The P&M Agreement is a complex, revocable instrument entered into under the authority of the Federal Property and Administrative Services Act and the Armed Services Procurement Act. It involves the coordination of action between echelons of navy command and other federal and local governmental agencies and is subject to the approval of the General Services Administration (GSA), disposal agency for the excess property.

The intent of the P&M Agreement is to provide benefits to the federal government and to state. The state takes on the financial and physical obligations of the Navy and GSA for protection and maintenance of the excess properties. In exchange, the state is allowed the interim use of these excess properties pending completion of disposal actions by GSA. The agreement further permits the state, with the prior approval of the Navy Contracting Officer and GSA, to license out any and all of the premises or facilities at charges representing fair market rental value. The monies collected by the state from any licensing are applied directly to the cost of providing protection and maintenance services. Any balance is paid to the U. S. Treasury.

The first P&M Agreement negotiated by NORTHDIV covered Fuel Tank Farms 4 and 5 and associated distribution facilities at the former Naval Supply Center Annex at Newport. Pursuant to that agreement, oil was stored at the fuel tank farms and the rental rate charged was $0.0867 per barrel per month.

The state's use of the fuel tank farms was an outgrowth of its anticipated critical shortage of heating oil during the 1973-1974 winter season due to the oil embargo. The Governor's office felt that the best interests of the people of Rhode Island would be served by having additional oil storage capability. During its one-year term, the agreement aided the citizens of Rhode Island by providing necessary fuel reserves during the critical shortage period. In addition to the estimated $300,000 saved by the Navy in protection and maintenance costs, the government received almost $1.4 million in net rental from the licensing of the facilities.

The impact of the SER Program at Newport and the Quonset Point/Davisville complex left the State of Rhode Island hard hit economically and with one of the highest unemployment rates in the country. To alleviate this hardship and further assist Rhode Island, NORTHDIV negotiated a second P&M Agreement with the state in early 1974. This agreement, which originally encompassed the majority of the excess airport premises and facilities at the former Naval Air Station at Quonset Point, now includes some of the excess properties at the Naval Construction Battalion Center (CBC) at Davisville as well.

Although the Newport P&M Agreement served as a prototype, the scope of the Quonset Point Agreement has been greatly expanded as a result of numerous modifications.

Under one of the modifications, the Navy permitted the state, at no cost to the government, to install an electrical transmission system which also included the construction of two electrical substations at the Quonset Point/Davisville complex. Authority for such installation was granted for mutual external needs.

The agreement was also amended to provide fire protection services from the state for Navy at both Quonset Point and Davisville. To facilitate the provision of these services, the Navy also leased to the state its two fire houses at the complex as well as fire-fighting apparatus and equipment. The Navy pays an annual monetary sum for this fire protection, and the state furnishes protection and maintenance services to the leased properties. These actions became necessary when CBC's fire-fighting department was disestablished.

The latest modifications to the Quonset Point P&M Agreement concern the utility systems. The state now operates, protects and maintains the entire excess sewer, water and steam systems at both the excess and non-excess areas of the complex.

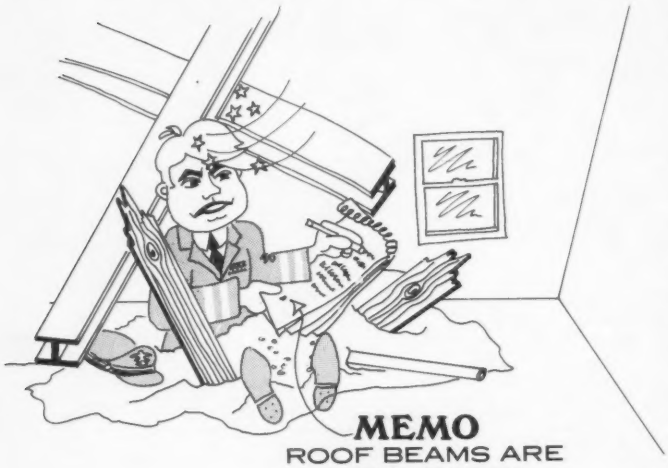
All requirements for the protection and maintenance by the state of the excess electrical distribution facilities within the areas covered by this P&M Agreement were deleted. A separate Electric Service Contract with the government provides those services. All necessary utility services other than electricity are furnished by the state to the government residual activities, to the government's tenants and to the state's licensees by separate utility services arrangements.

The Quonset Point P&M Agreement has also provided the local citizenry the use of the excess golf course and other recreational areas. It has made and continues to make possible the location of numerous commercial and non-commercial enterprises on what otherwise would be unoccopied property, thus discouraging vandalism. The business activity generated through the licensing provisions has contributed to the economic recovery of Rhode Island. The SER Program has alleviated the state's increased unemployment rate. In addition, it is estimated that the agreement has saved the federal government more than one-half million dollars in protection and maintenance costs during a period of extremely tight fiscal budgets.

Recently the Northern Division executed still another P&M Agreement, this one with the Economic Development and Industrial Corporation, an agency of the City of Boston, Massachusetts. It is for the protection, maintenance and interim use of the South Boston Annex of the former Boston Naval Shipyard.

It appears that the Protection and Maintenance Agreement would provide a viable solution for the problems of economic dislocation occasioned by future major base closures.

MAINTENANCE INSPECTION



• Alexandria, Va.

"Just use a little horse sense!"

This was the advice given a new inspector who was trying to determine whether a defect was too minor to report. The same guideline was also applied to determine whether engineering investigations or deferred maintenance was needed. No matter how a maintenance program is administered, the decisions of the inspector determine its success. To develop uniformity in maintenance administration, inspectors need specific guidelines; that is, horse sense must be quantified.

Maintenance inspection by degree-of-hazard is a management technique that attempts to limit common sense. It is an engineered approach to precluding trouble before "breakdown" by forcing answers to such questions as "How do you measure depreciation?" and "When is a public works facility unsafe?"

Development of specific inspection criteria which may preclude catastrophic failures is becoming increasingly important because of personnel reductions and limited funding. The program for maintenance management described here uses inspection by degree-of-hazard and is similar to the program in effect on crane and railroad trackage at U.S. Naval Shipyards.

Maintenance inspection by degree-of-hazard is based on the premise that safety is the primary concern. There are limits to the "can do" and "make do" philosophies of emergency repair. A newly constructed building is normally considered safe. When the roof collapses the building is generally condemned.

Between these extremes the designed safety factor is reduced and a degree-of-hazard exists. Using this idea, defects may be classified according to probability of failure. The resultant degrees-of-hazard can be grouped into broad categories entitled "Not Serious," "Potentially Serious" and "Serious."

Maintenance inspection classifying defects into degree-of-hazard categories can be used to certify safety. All public works (buildings, utilities, railroad and other facilities) should be certified safe annually, biannually or before use if inactive. Control and/or engineering inspections combined with degree-of-hazard classifications may be used as the basis for certification.

Identifying the danger signs of unsafe conditions becomes increasingly important as the backlog of maintenance increases; therefore, certification of safety is recommended. To accomplish this, commanding officers should designate an officer to be responsible for maintenance, inspection, and certification. When there is any question as to the degree-of-hazard, certification should be delayed until a detailed investigation and engineering evaluation has been completed.

The results of any evaluation, not the inspection, shall be the basis for certification of safety. Criteria for certification or allowing restricted operations pending repair is discussed under each degree-of-hazard classification.

Examples of degree-of-hazard are based on classifications used for crane and railroad trackage. Similar guidelines could be developed for other public works. Inspection criteria for public works are not very exacting and measurable tolerances have never been defined accurately.

Degree-of-hazard tolerances should not be confused with rejection criteria for new construction. Typical defects are listed under each degree-of-hazard category. Exceptions and variations to the classifications shown are expected. An inspector need not depend on his judgment alone in determining the degree-of-hazard.

In each instance of questionable condition, an inspector may request an engineering investigation or recommend stopping use of the facility until the deficiency is corrected and safe use is certified.

Not serious. These deficiencies do not affect safety of operation. Recording of these defects may be omitted at the discretion of the activity. Typical deficiencies include:

- Any rust stain, blistered paint, and/or minor pitting
- Crane trackage alignment deviation less than ½ inch in 62 feet

by degree of hazard

By DONALD K. JOHNSON
Facilities Maintenance Branch, NAVFAC HQ

- Wear on rails and large beams less than ¼ inch
- Structural joints with movement of less than ¼ inch

The basic "rule-of-thumb" in determining acceptability of a defect is ¼ inch of alignment or movement. All irregularities in wear, difference at breaks or joints, deflections, or alignment exceeding ¼ inch should be investigated.

Public works facilities with minor defects classified as "not serious" may be fully certified for all operations. These defects should be repaired, when possible, during regularly scheduled working operations, routine preventive maintenance (PM) or dynamic equipment inspection service (DEIS). A record of recurring and unrepaired defects should be kept current and the defects continually observed during all future inspections for progressive failure.

Potentially serious. Facilities with these defects may be used if additional safety measures are taken and continuous control inspections are made at intervals not exceeding six months. Typical deficiencies include:

- Corrosion—deeply pitted and flaking rust up to ¼ the thickness of structural member or bulkhead
- Base fractures on rails or beams over six inches long
- Fire hazards
- Wood railroad ties skewed more than eight inches

Excessive defects in this category may be classified serious at the discretion of the inspector and appropriate action taken. Portions of public works facilities with "potentially serious" defects may be scheduled for restricted operation or use at the discretion of the certifying official provided:

- Replacement or repair is scheduled
- Defective areas are marked with warning signs, when practical
- Operators and/or users are informed to proceed with caution
- Reduced operation is approved following an engineering evaluation
- Additional PM or DEIS inspections are scheduled

Serious. Sections of facilities with these deficiencies may not be used until repaired, or until an engineering investigation is completed. Typical deficiencies include:

- Rust and corrosion—where over ¼ the thickness of a structural member has deteriorated
- Complete transverse defect or fracture of a rail or beam with vertical or horizontal movement exceeding ¼ inch
- Cracks or splits in a single rail or structural member which add up to more than three feet of length in any ten feet of rail or member
- Any portion of a structure which experience and/or engineering judgment determine unsafe.

Temporary or emergency repair of serious defects may reduce the degree-of-hazard depending on the severity of the defect. Portions of public works which have "serious" defects shall not be certified. All usage shall be stopped until repaired and certified.

Sections of public works that are defective, damaged, misaligned or otherwise fail to meet established standards shall be barricaded, well marked with warning signs and all service discontinued. Facilities in this category may be condemned.

Do inspectors at your activity use specific guidelines similar to those shown above or do they have to rely on existing general instructions? Maintenance and Operation Manuals provide inspection checklists which emphasize points to investigate but do not give guidance for measuring defects. For example, a typical checklist will contain such items as: rust and corrosion; twisted, bowed, or deformed structural members; cracks, scaling or disintegration of concrete; and leakage or corrosion.

When any item on the checklist is defective, the inspector is required to describe the condition and recommend treatment. Inspector judgment varies considerably; therefore, it is suggested that detailed degree-of-hazard criteria be developed and used.

Maintenance inspection by degree-of-hazard is a workable management technique.

This is the inference reached after review of the inspection and certification program for crane and railroad trackage in effect at U.S. Naval Shipyards. To support this conclusion it is hoped that a program for maintenance inspection by degree-of-hazard will accomplish the following:

- Classify defects into categories to simplify the analysis of continuous inspections and provide documented justification for necessary repair or shut-down.
- Emphasize and ensure maximum safety by maintaining all facilities in a safe and sound condition. In general, this means custodial work will have the highest priority and cosmetic coating the lowest.
- Provide defect classifications that may be used to assign work priority. After the defense objectives and operational fleet requirements are met, priorities can be established for the specific needs of the public works facilities.

In view of the above COMNAVFACENGCOM HQ is considering applying this approach to other public works facilities. Would it work at your activity? Comments and suggestions on this article are welcome and should be forwarded to:

Commander
Naval Facilities Engineering Command
Code 1013
200 Stovall Street
Alexandria, VA 22332

Letters

- *MURPHY'S 200 YEARS*
- *A MUSEUM QUEST*

Dear Sir:

Your article entitled "200 Years" in the Fall 1975 issue of *Navy Civil Engineer* was worthwhile and easy for me as a junior CEC officer to relate to, especially regarding the description of the Navy's recent evolution of attitudinal changes, and reasons why young officers stay in or get out.

I wish to thank Professor Murphy for writing it, and also for his personal and concerned guidance while I was attending the CECOS Basic Course several years ago.

I especially value the perspective he brought to the CEC officer's role in relation to the rest of the "universe," and his ability to crystallize in written form the thoughts many of us have had in our early Navy years.

Sincerely,

J.C. Haug LT, CEC, USNR
Assistant Public Works Officer
Naval Research Laboratory

Dear Editor,

This letter is written as an extension of my close relationship with Ted Murphy while I have been stationed at CECOS.

Ted has prodded all the faculty and students at CECOS *to think* and his article of the last issue is no exception. I read his article "200 Years" anxiously awaiting his prod for me — the phrase that unintentionally was *meant for me.*

I had to wait until the last few paragraphs, and then I found it on page 38.

Specifically, I am puzzled by Ted Murphy's implication when he stated:

"More than one promising officer, in mid-career, has told us that he was considering leaving the Navy 'because it required the sacrifice of so many important personal moral values.' Willingness to compromise deeply held beliefs or values is diminishing, not only in the whole culture, but in the naval culture as well."

Are not beliefs or values of our American culture becoming more *permissive?* I think so! If this is true, then how can our officers be generally different than the society from which they come?

They must therefore be willing (permissive) to accommodate infringements of their values and beliefs that are not as deeply held as in the past.

Yes, there is an erosion of values of what *ought* to be, to preferences of what individuals *want* to be.

Maybe what these promising officers were trying to tell Ted was that their individual preferences (wants), not beliefs or values, are less uniform and they find these preferences more precious than the military imperatives that mean sacrifice in the form of separations and some hardships.

Outstanding job, Ted — *thanks for the prod.*

M. D. Porter,
CDR, CEC, USN
Executive Officer, CECOS

• And, Professor Murphy responds to CDR Porter's remarks:

Dear Mike,

I don't put the same construction on the word permissive that you do, and I can't follow your reasoning. No matter. But a phrase of yours intrigues me: "an erosion of values of what *ought* to be."

Who will decide what those values ought to be?

What I didn't say in the article — and probably should have — is that there are many *more* young officers who have decided to make a career of the Navy because their ideas are getting a better hearing than heretofore and who welcome the opportunity to influence the evolution of values, than there are who have dropped out. A matter of courage and durability.

Furthermore, this is happening because of a significant number of senior officers who empathize. They have for years been bursting at the seams with sensible, constructive ideas of their own for change; and they have become the real agents for it. I see this as *rejuvenation,* not erosion, Mike.

I think what the career officers — junior and senior — are saying is: We have had enough of hypocritical, cynical pleonasms. Let's reconstitute professional integrity and leadership to fit a humanized Navy. Let's make our deeds fit our self-righteous words.

You're welcome, Mike.

T. C. Murphy
Professor Emeritus, CECOS

Dear Sir:

The CEC/Seabee Museum at the Seabee Center, Port Hueneme, Calif., is in need of the following items to complete a new exhibit under construction:

• A dress khaki CPO arm rating badge of one of the following WWII ratings: carpenters mate; motor machinist mate; machinist mate; electricians mate or shipfitter metalsmith.

• The following uniform pieces: green Seabee baseball type cap as worn up through the 1950s; blue baseball type cap as worn in recent years with dungarees; 4 CPO or officer style combination hats, with one each white, blue, khaki and green cover; Navy watch cap; gray WWII overseas cap; green overseas cap; official beret that might have been worn by Seabees on special assignment or as a Band member; WWII CPO or officer gray uniform as complete as possible.

Persons wishing to donate any of the above to the Museum are requested to contact the museum at (805) 982-5163.

Thank you.

Y. H. Ketels
Director, CEC/Seabee Museum

• Readers of *The Navy Civil Engineer* are always invited to comment on the contents of the publication. Letters should be addressed to The Editor and must be signed with return address and Autovon or commercial telephone numbers. Comments, generally, should not exceed 250 words.

Some historic structures are registered and must be preserved

The bicentennial year has stimulated much interest in historical sites, and public works personnel should be alert to potentialities on Navy bases.

Most readers leafing through this magazine may be aware of the national historic preservation policies and if they are don't really expect to be involved. However, it may crop up in ways and at times that are totally unexpected.

Executive Order 11593 requires all federal agencies to inventory their land holdings for historic structures and to nominate to the National Register of Historic Places those that qualify under acceptable standards set by the National Park Service.

As this has already been done throughout the Navy, it would seem that whatever type project you may be working on, all that is necessary is to refer to the National Register to assure yourself that no historic places are involved.

It seems logical, but it doesn't work quite that way.

The Navy is responsible for preserving and maintaining property under its jurisdiction that is included in the National Register or qualifies for it and consequently may not act on an undertaking which would adversely affect such property without first submitting modification proposals to the National Advisory Council on Historic Preservation for review and comment.

The problem arises from the fact that someone — and that includes anyone who can write a letter — may see some historical significance or some architectural excellence unseen by those who inventoried the property for the Navy.

He may, perhaps, believe that a site contains archaeological artifacts buried beneath the ground. A letter from that someone to the National Park Service or the National Advisory Council will produce a routine reminder that under section 106 of the Historic Preservation Act of 1966 the Navy cannot proceed with an undertaking that will have an effect on property that is included or is eligible for inclusion in the National Register without first submitting the undertaking to the Advisory Council for review and comment. At this point any project which may be underway comes to a screeching halt.

Over a year ago at NAS Moffett Field a routine demolition contract was let to get rid of some old buildings within a housing area. The buildings were on an area acquired some years ago, but subject to a life estate which had recently terminated. The buildings were quite dilapidated and the local building inspector considered the main building, formerly a residence, beyond economical repair.

However, a local historical society saw some historical or architectural significance in these buildings not apparent to the Navy.

Now over a year later the main house and a water tower remain and are included in the National Register of Historic Places. It qualified, not for architectural reasons, but because it had been the residence of several men who had attained some local prominence. Perhaps these buildings will still be demolished, but if they are it will only be after a considerable period of review and consultation.

Whether you are a planner, a MILCON programmer, or a construction type, you just might get involved in a situation similar to this for it is not an isolated example. There is apparently no way completely to avoid this type of situation. But it could help if everyone who is involved in a project would realize that even the most uninspiring piece of property may have those who love it.

Look at it through their eyes.

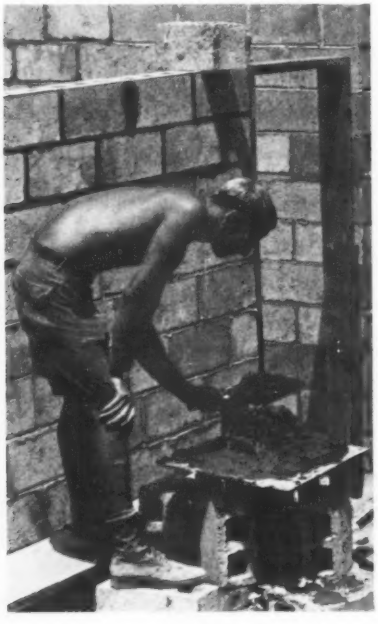
For further information, contact R. Markon, Code 20R, NAVFAC HQ, Autovon 221-0437.

PUBLIC WORKS TECHNICAL NOTES

It is said there's always a way to build a better mousetrap and this section of The Navy Civil Engineer is designed for ready exchange of better ways to perform Public Works functions. Readers who desire additional information are urged to contact the contributor directly for specific details. Contributions are urged from field installations and should be directed to John S. Biggs, PW Technical Coordinator, Code 1013, Headquarters, Naval Facilities Engineering Command, 200 Stovall Street, Alexandria, VA 22332; Autovon 221-8182 or (703) 325-8182. Coordinator for RDT&E subjects is Eugene H. Early, Code L03C, Civil Engineering Laboratory, Naval Construction Battalion Center, Port Hueneme, CA 93043; Autovon 360-4070 or (805) 982-4070.

Masonry cement is out!

Masonry cement has been *excluded* from Federal Construction Guide Specification primarily because masonry cement mortars have high air contents which are detrimental to the compressive and bonding characteristics of mortar. It is believed that the poor bonding characteristics of masonry



cement are responsible for many masonry leakage problems. It appears that the basic problem with masonry cement is the inability to determine the limit on air content which would preclude detrimental effects on the performance of the mortar.

Additional information may be obtained from NAVFAC HQ, J. Long, Autovon 221-0058.

Chlordane and heptachlor usages explained

The EPA announcement widely reported as a "ban on the use of chlordane and heptachlor" has been largely misinterpreted by many people. To set the record straight all chlordane and heptachlor *now* in the channels of trade (this includes Navy and other DOD stocks) may continue to be used for control of pests as indicated on the label. The EPA did halt the manufacture of chlordane and heptachlor for all uses *except* termite control and root dipping of non-food plants which will apparently continue to be registered uses for these materials even after all other uses are illegal.

Continue use of present stocks of chlordane and heptachlor, within label guidelines; any change will be officially communicated to all shore activities.

Additional information may be obtained from Southern Division NAVFAC — C. W. Bennett (Code 10A1), Autovon 794-4155.

Lamp ballasts waste energy

By now you have all taken the required steps to reach the reduced lighting levels required by Federal Management Circular 74-1.

But have you done the job in the best way where fluorescent lamps are involved?

Ballasts use energy, even if the lamps are removed. If both tubes are removed from a ballast designed for two 40-watt tubes, the energy consumption will be reduced from 94 watts to about 6 watts, but the current seldom changes and the power factor drops to a miserable 12%. If only one lamp is removed from such a ballast, the ballast will overheat enough to shorten its life, and possibly cause a fire.

For maximum safety, be sure to remove both tubes. And, for maximum conservation, disconnect the ballast whenever your workload permits.

Additional information may be obtained from Atlantic Division, NAVFAC, Davis N. Rogers (Code 101), Autovon 690-7121.

PUBLIC WORKS TECHNICAL NOTES

JP-5 fuel can be used for diesel operation

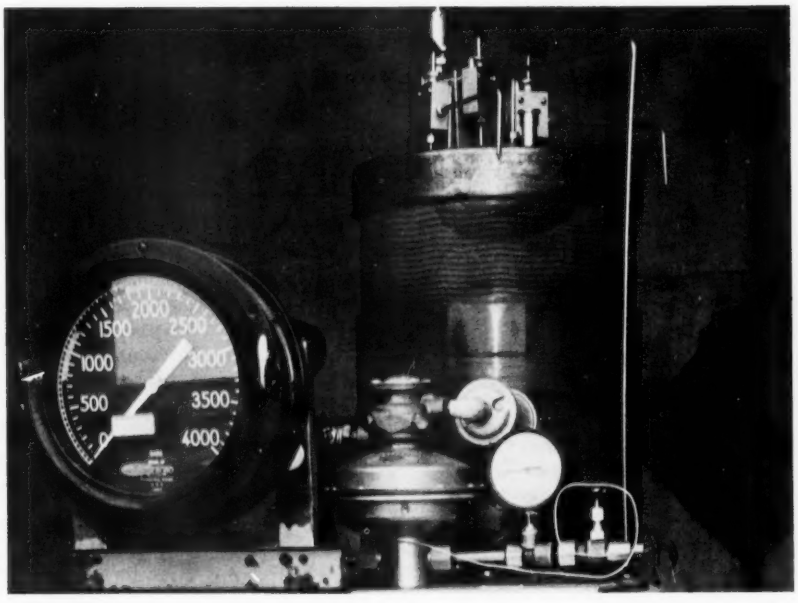
When necessary, the adaptation and use of JP-5 fuel as a substitute for diesel fuel in civil engineering support equipment (CESE) is acceptable in both short and long term situations when properly controlled.

The Civil Engineering Laboratory (CEL) has completed the testing of JP-5 as an alternative fuel to diesel fuel. The results, published in "CBPAC/CBLANT Equipment Officers Technical Bulletin Number 3-74 of 21 February 1974" by E. T. Smith and A. A. Kannegieser were that JP-5 is an alternative to diesel fuel when necessary but the use in CESE can result in excessive injector and injection pump maintenance if proper care and preventative maintenance steps are not taken.

This adaptation will create more flexibility in the Navy CESE environment with the increase in cost and decrease in availability of diesel fuel. Care must be emphasized to insure that fuel is free of particulate matter and water. Maintenance acceleration will be necessary for the fuel injection systems in order to minimize breakdown maintenance.

Additional information may be obtained from Atlantic Division, Thomas H. Walker, Transportation Equipment Management Center, Code 1225, Autovon 690-1209.

Rent — don't buy specialized instruments



Do you need instruments? No doubt, you have a ready assortment of everyday instruments, such as volumeters, ammeters, and ohmmeters. But what about the rare times you need a fault detector, leak detector, sound or noise meter, or pollution detector? These are expensive to buy, and usually are used for a short time. At least one of the nationally prominent electrical supply manufacturers has a rental inventory of instruments and accessories made by over 70 instrument manufacturers. Instruments for measuring electrical and non-electrical quantities are quickly available for rental, ranging from $25 per month to several hundred dollars per month. The same sources may also sell used instruments of all makes, which they claim have been reconditioned to new instrument condition.

Additional information may be obtained from Atlantic Division, NAVFAC, Code 10, Autovon 690-7121.

Air Conditioning Myths

In past decades of abundant cheap energy it was common practice to design and install air conditioning systems disregarding operating costs.

During this same period electric utilities were using a "hard sell" line, *"The more you use the less it costs."*

However, with the advent of energy shortages it has become necessary to design and operate air conditioning equipment in the most economical manner. A few of the more common misconceptions about air conditioning systems are: incoming cold air must be reheated for humidity control; humidity control is required for personnel comfort and that humidity can be just as effectively controlled with chilled water coils as with direct expansion coils.

Other false beliefs are that office buildings with large interior areas must use heat in conjunction with air conditioning in these interior areas to compensate for the high heat load around the perimeter of the buildings; moisture at the diffuser is caused by lack of reheat, air conditioning units sized too small will continually "trip off the line" and that steam absorption chillers are too expensive to operate.

Energy saving *facts* that should be considered are: cooling coils automatically restrict humidity levels, the amount depends on the degree to which the air is cooled; humidity control is not a requirement for personnel comfort; and that the lower cooling coil face temperatures of direct expansion coils result in a more effective humidity control.

A better and less expensive method to control office building interiors would be to reduce the volume of conditioned air supplied to the interior areas.

The major cause of moisture at the diffuser is too great of an air velocity across the face of the cooling coil. This results in moisture carryover.

An air conditioning unit sized too small will not trip off; however, it will not meet the thermostat's demands, either. A unit sized too large will trip off the line due to low load demands.

Steam absorbers are very economical where the primary steam is generated for other purposes such as process, generation of electricity, etc.

Additional information may be obtained from Mr. H. J. Wall, Southern Division, Charleston, S.C., Autovon 794-3870.

A new bait blocks termites

A NAVFAC/Forest Service study underway at NAVSTA Midway and NAS Patuxent River involves a new technique which uses bait blocks infected with an attractant fungus — sterilized and then impregnated with a new insecticide. Field test results will establish most effective application and least cost of this unique and low cost termite control. Such field data are expected within a year. Preliminary test data indicate one pound of insecticide in bait blocks placed two inches in the ground at five-foot spacing near the foundation will be enough to treat and protect 900 average size houses. Existing protective treatment requires as much as two and one half pounds of chlordane with 25 hours labor vice 15 minutes for the bait application per building.

Additional information may be obtained from R. Z. Page, Code 104B, NAVFAC HQ, Autovon 221-8175.

Elemental analysis by X-ray

• Port Hueneme, Calif.

Several times monthly the Navy Environmental Support Office (NESO) receives calls asking:

"What can I do with 150 drums of liquid waste that are sitting on the quay awaiting disposal?"

Usually, when asked what the wastes contain, the answer is simple, "I'm not sure."

Because the nation's environmental laws are specific in regards to certain pollutants, waste material must be identified before it can be disposed. Identification usually requires chemical analysis.

Elemental analysis provided by atomic absorption or colorimetric techniques are accurate but expensive and time-consuming. This is especially true if one must screen a liquid or industrial sludge for a large number of elements. In fact, one should expect a cost of $200 to $350 per sample coupled with a three to four week wait.

To help alleviate this problem, NESO has evaluated an x-ray fluorescence analytical technique that can rapidly and inexpensively be used to analyze a sample for a wide range of elements. Furthermore, the technique is applicable for both liquid and solid samples and provides a non-destructive analysis for the latter.

The analyses are made by measuring the total energy of the x-ray fluorescence radiation produced from a sample by means of an x-ray energy source. This induced radiation is separated into wavelengths characteristic of specific elements in the sample.

Costing less than $60 per sample analysis, the x-ray fluorescence technique provides quantification of 48 elements within two or three days.

The following table shows detection limits in parts per billion (ppb) for the 48 elements of interest:

Information concerning x-ray fluorescence analytical techniques or about many other environmental matters can be obtained from NESO Environmental Information Coordinator, Autovon 360-4182 or Area Code 805-982-4182.

X-RAY FLUORESCENCE ANALYSIS
Concentrations are in μ/1 (ppb)

Antimony	**10**	**Gallium**	**0.7**	**Niobium**	**9**	**Silver**	**5**
Arsenic	**0.7**	**Germanium**	**0.9**	**Osmium**	**7**	**Strontium**	**5**
Barium	**50**	**Gold**	**3**	**Palladium**	**7**	**Tantalum**	**30**
Bismuth	**2**	**Hafnium**	**9**	**Platinum**	**5**	**Tellurium**	**20**
Bromine	**1**	**Indium**	**5**	**Potassium**	**200**	**Thallium**	**2**
Cadmium	**5**	**Iodine**	**20**	**Rhenium**	**10**	**Tin**	**20**
Calcium	**70**	**Iridium**	**7**	**Rhodium**	**7**	**Titanium**	**20**
Cesium	**30**	**Iron**	**3**	**Rubidium**	**3**	**Tungsten**	**20**
Chlorine	**300**	**Lead**	**1**	**Ruthenium**	**7**	**Vanadium**	**9**
Chromium	**7**	**Manganese**	**5**	**Scandium**	**50**	**Yttrium**	**7**
Cobalt	**2**	**Mercury**	**2**	**Selenium**	**0.9**	**Zinc**	**1**
Copper	**1**	**Molybdenum**	**7**			**Zirconium**	**10**
		Nickel	**2**				

Naval Facilities Engineering Command
SITUATION REPORT

MUSE MAINTENANCE PLANNING - Standard procedures for streamlining and simplifying equipment maintenance requirements are being developed for use by using activities. A comprehensive screening and consolidation of manufacturers' O&M manuals and related software is being conducted to identify inspection and maintenance requirements for each class and type of MUSE. Features of the Navy Maintenance and Material Management (3-M) System are being incorporated whenever possible. A prototype plan has been prepared for one class of 750 KW and 1500 KW diesel power plant which is now being field tested. (NAVFAC Code 10)

NAVY FORESTRY PROGRAM ACTIVE - In spite of depressed market conditions, a new high of $1,960,641 in proceeds from timber sales at Department of the Navy activities was reached during FY75, the previous record being $1,907,682 in FY74. The excess of proceeds over expenses for FY75 was $1,031,336. Long range forest resource management plans provide for timely harvesting of timber, reforestation, timber stand improvement, timber area access road construction and maintenance, forest protection, and multiple-use management, while recognizing the interdependence of all renewable natural resources and environmental impacts of forestry operations. (NAVFAC Code 20)

NAVY MAINTENANCE DREDGING - NAVFAC through the Naval Environmental Protection Support Service has implemented a program of environmental surveys of major Navy porting locations. These field surveys are to assess the local situation to establish a uniform approach for permit application; agency negotiations; and EIS development and to obtain long term (ten year) dredging permits. Four such surveys have been completed in FY75 with encouraging results. A ten year dredging permit was issued by the Corps of Engineers (COE) for NSY Philadelphia; a second application for long term dredging was submitted for NSY Charleston; a third is in process for NAVSTA Norfolk. The survey efforts have developed into a team-approach with the COE and Navy commands in the area of dredging. For example Navy EIS are being included in the COE EIS preparation. Payback to the Navy is cost savings and effective dredging operations. (NAVFAC Code 10)

Continued on page 36

Naval Facilities Engineering Command
SITUATION REPORT

SOLAR ENERGY FOR FAMILY HOUSING - NAVFAC has forwarded preliminary site selections to an OSD/Tri-Service A/E firm for preliminary design of solar heating and domestic hot water systems for 17 units of family housing at five locations. At New London, CN and Twentynine Palms, Calif., five existing units will be modified for solar and at Charleston, New Orleans, and San Diego, 12 new family housing units will be designed with integral solar energy systems. Funds for these innovations are provided by the Energy Research and Development Administration (ERDA). (NAVFAC Code 08)

THE BUDGET AND IMPOUNDMENT CONTROL ACT OF 1974 has created changes in Congressional procedures which in turn cause changes in MCON programming procedures. Two significant changes are that the fiscal year will begin on 1 October rather than 1 July, and each MCON program will be submitted to Congress twice, with the first submission being approximately one year earlier than usual. As a result, NAVFAC Headquarters has already begun to authorize preparation of 30% design on about 50% of the FY78 MCON program. Design authorization for additional FY78 projects is planned for January and September 76. Formulation of the FY79 MCON program is now in the initial stages. The first iteration of this program has been mailed to Major Claimants. Additional iterations will take place through June 76. EFDs will be required to certify and validate FY79 projects commencing with the third iteration in December 1975 and ending with the fifth iteration in April 1976. The June iteration will reflect the FY79 MCON program as it will be submitted for consideration in early July 1976. (NAVFAC Code 05)

DRY SCRUBBERS SAVE NATURAL GAS AT FIRE FIGHTING SCHOOL - The existing afterburner at the San Diego Fire Fighting Training School has been highly effective in reducing the objectionable black smoke from fire extinguishing drills, but more than 400,000 MBTUs per year of valuable natural gas are consumed as afterburner fuel to achieve the clean exhaust. Testing of an experimental continuous cleaning dry filter scrubber using only 12% of the energy of the afterburner promises equally acceptable smoke emissions with an attendant simple amortization payback of less than five years. A MCON Project for this equipment is presently included in the FY78 Energy Program to install such a scrubber at the San Diego School. This is but one example in which innovative thinking applied to a significant requirement resulted in an alternative method that gets the job done while conserving energy. We appreciate and can use a lot more such ingenuity. (NAVFAC Code 10)

Superbattery!

By F. E. ROSELL, JR.
Senior Project Engineer
Naval Nuclear Power Unit

• Fort Belvoir, Va.

The Navy half-watt radioisotope thermoelectric generator (RTG) crams over 60,000 watt hours of electricity into a two-pound package as small as a flashlight. That is as much power as produced by standard lead acid automobile batteries weighing 3.5 tons. Imagine a 6-volt battery operating for more than 125,000 hours (about 15 years) and continuously providing 80 milliamperes of current for an electronic load of about 85 ohms.

That's what the Navy Superbattery will do!

Miniaturization in the past decade has so reduced the power demand of electronics that many sensors or other devices can now operate with less than one watt of power. And often these devices must operate in remote or inaccessible locations where it is impractical or too costly to pipe conventional power to them or to replace periodically a conventional battery or other shortlife power source.

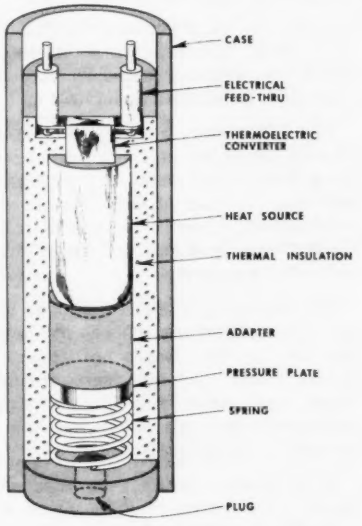
The Naval Facilities Engineering Command recognized the need for reliable remote power sources more than a decade ago and developed a family of RTGs which would provide from 1 to 100 watts of power for a minimum of five years.

One RTG has been operating a remote weather station in Alaska for more than eight years. Several of these RTGs are presently available at the Naval Nuclear Power Unit for loan to Navy users. Older typed of RTGs are fueled with strontium 90 which requires heavy shielding against the radiation involved. They are elephants when compared with the new miniature Navy half-watt RTG.

The new generation of electronics requires miniature power sources to match the miniature electronics. Using a plutonium-fueled heat source developed under sponsorship of the Energy Research and Development Agency (ERDA), the Navy contracted with each of four firms to design and build two demonstration models of the superbattery. These eight demonstration model RTGs were delivered to the Naval Nuclear Power Unit Sep-Nov 1975.

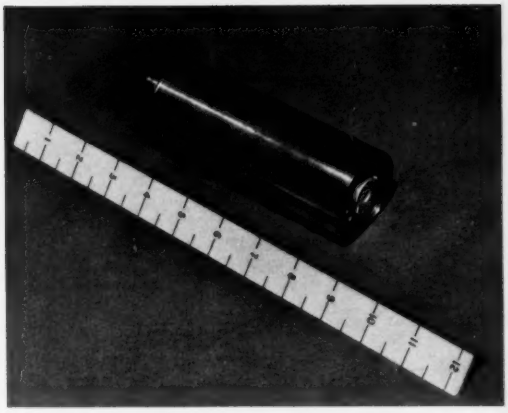
In principle, an RTG is a simple electrical device. The heart of the device is a thermoelectric converter made of semiconductor materials which convert heat directly into electricity when there is a temperature difference across the converter. To make the converter work, a heat source keeps one side hot and a heat sink (radiator) keeps the other side cool. Two elecrical leads conduct the DC electricity out of the converter.

The physical form of the Navy Superbattery is also simple. The RTG consists of an outer case, electrical feedthroughs, thermoelectric converter, heat source, thermal insulation, adapter,



pressure plate, spring, and plug. The outer case functions both as a container and a heat sink. The adapter stabilizes the heat source alignment and presses the heat source against the thermoelectric converter. The pressure plate distributes the spring pressure over the adapter end surface. The spring maintains pressure between the heat source and the thermoelectric module and between the thermoelectric module and the heat sink. The plug provides access to the interior for evacuation and for back filling with gas. The thermal insulation improves efficiency by reducing heat losses and helping to confine the flow of heat from the heat source to the path through the thermoelectric converter.

The Navy Superbattery used bismuth telluride as the thermoelectric material. The secret of the battery's long life is



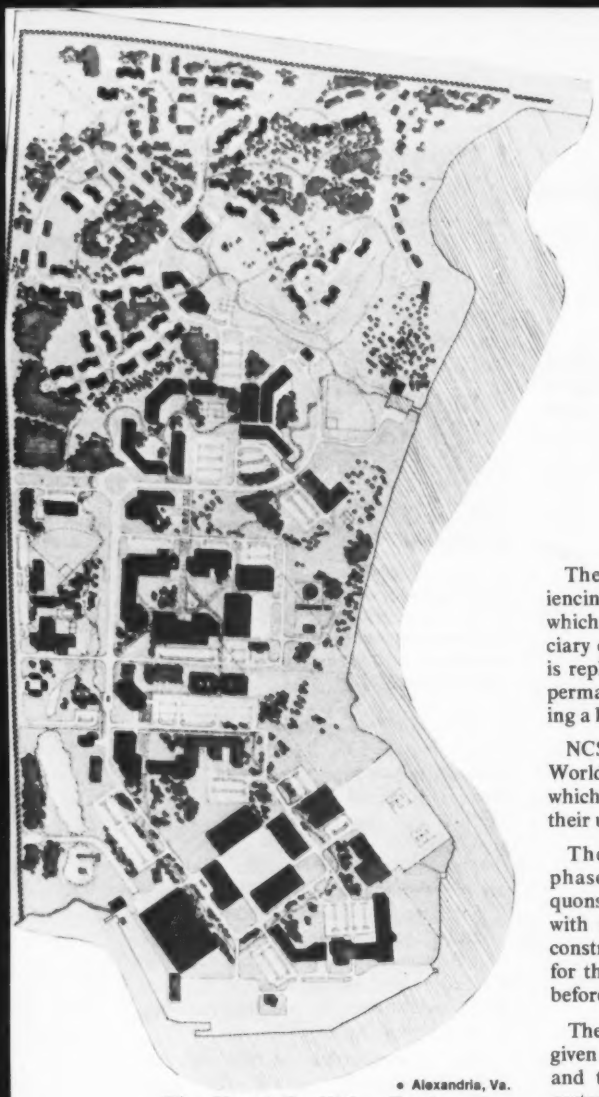
Power — A Radioisotope Thermal Generator — RTG — is a tiny device used to provide a half-watt of continuous electrical power for remote installations. The RTG can supply 60,000 watt-hours of electricity during its long life.

a miniature heat source 0.98" (2.49 cm) diameter, 1.96" (4.98 cm) long containing radioactive plutonium oxide. Heat is produced by the nuclear decay of this fuel, but the decay is so slow that after 86.4 years only half of the fuel is consumed. The radiation levels are low enough that biological shielding is not required. The fuel is encased in a triple layer capsule designed to contain the fuel under all credible accident conditions and to meet safety requirements established by the International Atomic Energy Agency.

The demonstration models of the Navy Superbattery are 2.0" (5.08 cm) in diameter and 5" to 6" (12.70 to 15.24 cm) in length. The contractors believe that with the present heat source it is practical to build RTGs as small as 1.6" (4.06 cm) in diameter and 4.0" (10.16 cm) long. A study is being made to determine the minimum practical size that could be achieved.

The Navy Superbattery is designed for use where small, long-life distributed power sources of high reliability are required. Initial use will probably be in cables in undersea surveillance systems. Other potential uses are anticipated such as in fiber-optic cables, remote point sensors (meteorological and other), and remote communications stations.

The Naval Nuclear Power Unit has been assigned responsibility for procurement of the Navy Superbattery. Reliability and life testing of the demonstration units and components are in process. Procurement of smaller, improved models is anticipated in the near future. The Superbattery represents a milestone in the Navy's effort to develop small, reliable long-life nuclear power sources.



• Alexandria, Va.

Master Plan For A Lab

By DANIEL J. FEIL
Installations Planning Division
NAVFAC HQ

The Naval Facilities Engineering Command is currently preparing a master plan for the Naval Coastal Systems Laboratory (NCSL), Panama City, Florida.

The master planning process for NCSL has been the year long effort of a multi-disciplinary team from NAVFAC whose members represent various allied professions such as architecture, landscape architecture, community planning, urban design and electrical, mechanical, structural and sanitary engineering. Operations analysis was also used during preparation of the master plan.

NCSL has been commissioned by the Chief of Naval Operations as the principal Navy research, development, testing and evaluation (RDT&E) center for the application of science and technology to coastal region military operations.

It is located on about 700 acres of land along St. Andrew Bay near the Gulf of Mexico in Panama City, Florida. Over 700 military and civilian personnel work, and over 200 dependents live on this installation valued at over $47 million.

The laboratory is currently experiencing two different but related events which make it a potential prime beneficiary of a master planning effort. NCSL is replacing outdated facilities with new permanent construction and is becoming a host to a number of Navy tenants.

NCSL has an extensive collection of World War II vintage metal buildings which are extremely inefficient both in their use of land and to maintain.

The laboratory recently began a phased program of replacing these quonset huts and metal clad buildings with new facilities of more permanent construction. However, no overall plan for the location of new facilities existed before this master plan.

The laboratory functions well at its given intensity of use of both the land and the facilities. Roads are not congested, except to a minor degree at rush hours, and many facilities, although expensive to maintain and at times overcrowded, generally serve well.

These facilities are, however, not well located and much fragmentation of individual facilities and functional areas exists.

In addition, some facilities with little or no relation to each other find themselves in close proximity because of the need to use space when and where available and the inherent inefficiency in having a series of scattered, small buildings over a large area of land.

The current inventory of one story, metal buildings requires a great deal of land for the amount of space enclosed. This severly restricts development of new buildings; and expansion of these outmoded and inefficient structures, along with a better road system will greatly aid the orderly growth of NCSL.

A minor problem is location of certain facilities relative to the secure area. In view of the current base mission and loading, this is not a severe problem.

However, the laboratory recently took on the role of host to a number of tenants, whose location at Panama City permits more efficient use of resources at NCSL. As the installation develops, current problems can be expected to intensify and new ones may appear.

The master planning process involves identification of existing and potential problem areas and seeks solutions in terms of organization, locations (land use), circulation and utilities.

Problems of growth of NCSL involve the transition zones between individual activities and the base as a whole and its surrounding neighborhood. Currently, undeveloped areas successfully provide buffer areas between different land uses on the installation but development requires their being more forcefully defined and cultivated.

Other types of buffers have been developed. Similarly, operations near the installation perimeter, due to the need for a more intensive use of certain parts of the land, are sensitive to nearby, private land use and public plans or zoning codes when applicable.

Environmental and functional constraints to growth have been identified in order to avoid costly site development, to conserve and protect the natural environment and to permit operation of the laboratory during construction.

The Naval Coastal Systems Laboratory, with many obsolete facilities and facing new expansion can reap the benefits of a master planning effort. The master plan identifies and addresses the problems of NCSL due to current conditions and those projected due to future mission assignments.

This plan, developed for a moderate sized R&D oriented activity, represents some of the latest approaches to master planning and incorporates the latest concerns for the environment, land use and energy and utilities conservation. The methodology used will be the forerunner for broader future plans for other activities throughout the Navy.

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"Sops Up Oil Spills When 'Chips' are Down" - CEL

• Port Huemene, Calif.

An open sea oil spill recovery system, designed by the Navy to pick up 50,000 gallons of oil an hour, could prevent major spills from reaching coastlines if deployed in time and in sufficient numbers.

The Civil Engineering Laboratory (CEL), Naval Construction Battalion Center, Port Hueneme, Calif., has developed a concept which uses 3.6 million polyurethane foam chips an hour to absorb the spill. The chips are sprayed across a 20-foot path of oil; guided onto a collecting belt; squeezed "dry" of the oil, and returned to the system for reuse. It takes a single chip about 60 seconds to complete the cycle and is reuseable for at least 50 clean-up runs.

Successful open sea tests have been conducted in rough waters with four-foot waves with CEL's mechanized sorbent oil spill recovery system. Modifications are underway before the prototype is subjected to additional tests.

"If the recovery system had been available in 1969, the Santa Barbara offshore spill (approximately 4 million gallons) might not have been such a tragedy," said Dr. James J. Der, senior research mechanical engineer in charge of the project.

Long-range plans call for a fleet of recovery systems to be located strategically along both coasts and other areas facing possible ship oil spill disasters. The Navy's Supervisor of Salvage, sponsor of the CEL project, had requested development of a recovery system that could be deployed by aircraft and be operable in the water within 24 hours. The CEL concept can be operating in the waters within 12 hours.

The working model recently tested four miles at sea is 75 feet long and 20 feet wide. The system can be attached to the side of a seagoing tug, work barge, or an ARS class of ship. The system includes the "broadcaster" which distributes the sorbent chips into the water; and a herding barrier which confines the oil as it enters a channel formed by a dike (modified oil boom) on one side and the vessel on the other. It is between these boundaries that the oil is adsorbed by the urethane foam sorbent chips. A harvester picks up the oily chips as they flow to the end of the herding channel; and a regenerator then de-oils the chips by mechanical squeezing.

The "dried out" chips are recycled to the broadcaster by a series of conveyor belts.

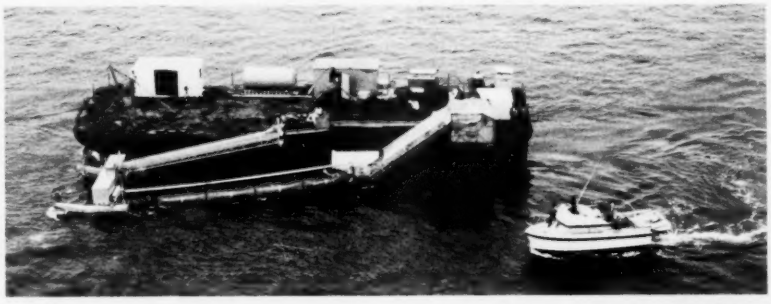
With the ship advancing at two knots, the recovery system can operate satisfactorily in five-foot waves and still soak up 90% of the oil spill it traverses. Unlike many other oil skimmers that function better in calmer waters, the CEL system performs more efficiently in choppy seas. The rougher the sea state, the more oil comes in contact with the chips, enabling the chips to adsorb the spill more effectively, even in winds up to 25 miles an hour.

With results of the sea test proving that the concept of mechanized handling of sorbent materials is workable in open water, CEL is now modifying the system to make it smaller and to reduce its overall weight from 20 tons to 10 tons. The redesigned version will undergo quantitative performance data tests this summer in the Environmental Protection Agency's oil and hazardous materials simulated test tank at Leonardo, N.J. Tests for collection efficiency (amount of oil collected per hour) under varying conditions will include wave height, operational speed, and oil slick thickness.

The development of the system was based on analysis of assorted data compiled from works funded by EPA, the American Petroleum Institute, and laboratory. Additional data was obtained by CEL from contracted laboratories. In conjunction with EPA scientists, CEL closely reviewed results of five studies sponsored by the agency. Various experimental components, proposed by the five organizations, helped to establish a high potential of success.

(Continued on next page)

Chips Ahoy — The CEL-developed Sorbent Oil Spill Recovery System spreads millions of styrofoam chips on an oil spill. The chips adsorb oil, are then gathered, and "squeezed" dry.



Oil Spills

(Continued from page 41)

For more than a year, the laboratory conducted further studies and system analysis, resulting in a basic design. When specifications were developed, a contract was awarded for detailed design and fabrication. Through close monitoring of the contract, the laboratory ensured a cost-effective, successful end product.

The importance of using foam chips with proper buoyancy was revealed in early sea trials. To maintain operational efficiency, it is imperative that the system contain the sorbent chips within the herding barrier. During initial tests, a significant number of chips had surfaced behind the harvester and escaped astern. The loss rate was about 20 chips per minute. Although the percentage was small (0.03%), compared to the broadcasting rate of 1,000 chips per second, the loss would have posed a problem in actual operations if not corrected.

Recovering an oil spill at sea, the system would have to be replenished within hours (maximum broadcasting capacity being 30,000 chips). And a large number of oil-soaked ships would have escaped to the environment, an unacceptable predicament.

Accordingly, a new type of chip (20% closed cell) was introduced into the system. Since they were pink in color, the chips were easily identifiable from the original buff colored (100% open cell) chips. The new closed cell "pink chip" was not seen to escape the system during normal operation. Engineers conclude that when sorbent chips with proper buoyancy are used, the system retains them throughout the cycle.

CEL solved another problem vital to a viable recovery system by determining a proper and accurate sorption rate (capacity versus time) of the chip when dispersed into a spill.

After testing various materials, the laboratory selected a polyurethane foam chip (3" x 3" and ¼" thick) which becomes 90% saturated within six seconds. This enables the system to recover the maximum amount of oil without the chip becoming water soaked and sinking below the surface and escaping. The chip, with the right buoyancy and soaking oil at a desirable sorption rate, floats through the herding channel in a designed manner toward the regenerator.

According to Navy definition, a "large" oil spill involves more than 100,000 gallons. A "moderate" spill entails 10,000 gallons and a "small" spill is less than 10,000 gallons. Approximately 90% of open sea spills involving Navy ships fall within the "small category. But the occasional large spill is the one that threatens to be catastrophic in terms of environmental damage to beaches and coastal properties.

Operators of the CEL recovery system have several options in storing the oil, depending on the size of the spill. The oil could be stored aboard a service barge if the spill were small, or it could be pumped by hose connected to a support service vessel, or discharged into floating rubber tanks which can be towed to the scene.

It is anticipated that by early 1977, the CEL recovery system will be delivered to the Navy's Supervisor of Salvage for open sea clean-up operations involving Navy ships.

TRIDENT'S DRYDOCK

(Continued from page eight)

mental considerations associated with pumping the aquifer; i.e., salt water intrusion and effect on on-station and off-station water supplies, the aquifer was divided into three geographic zones:

Zone I: This zone is generally limited to the off-shore site of the drydock/delta facilities. Characteristics of this zone are that the natural aquifer venting occurs here, it is the area that will require the largest drawdown, coupled with the largest possibility of salt water intrusion.

Zone II: This zone is "up stream" of I but is bounded totally on base. The Trident base water supply will be obtained from this zone.

Zone III: This zone extends from the on-station boundary of Zone II to an undefined limit off-station and includes the remaining up-stream portion of the aquifer and its contributing natural underground reservoirs. This zone is potable water and shall, by design, be unaffected by the aquifer relief system.

The drydock aquifer relief system, which will allow construction and operation of the drydock, consists of the functional integration of three separate deep well and dumping systems.

The first system is an upland, on-shore system. Located in Zone II, this system will pump approximately 1,200 gpm from the aquifer. During drydock construction and initial stages of the Trident facility build-up, this system will recharge the water back into the aquifer at an upland (Zone II) position.

As the Trident water supply demand increases to its estimated 1,500 gpm maximum, this system will become the primary source of water and the recharge wells will be shut down.

This system will lower the artesian head at the drydock to an elevation of approximately 15 feet above MLLW (EHW is elevation 14.7 above MLLW), the elevation required for the service life of the drydock.

The second system, located in Zone I, consists of a line of wells and pumps along the shoreline. This system will lower the head at the site of the drydock from 15 feet above MLLW to 0 elevation MLLW. This is to allow minor dredging and the installation of the drydock sheet pile cells which will form the exterior of the drydock and house the third pumping system.

The third system, also in Zone I, is a series of wells and pumps located on each side of the drydock caissons. These pumps will be capable of lowering the artesian pressure directly under the drydock to an elevation of -68 feet below MLLW. This is to allow dewatering of the drydock area within the sheet pile cells and subsequent construction of the floor and walls of the concrete drydock.

The total pumping capacity of all three systems is some 5,200 gpm. Salt water intrusion, if it occurs, will be controlled and limited to Zone I by balancing the pumping rates and thus the hydraulic gradients of the three systems.

Drawdown of the off-base portion of Zone III during the construction of the drydock will be maintained as near zero as possible by means of monitoring and adjusting the acquifer pumping and recharge rates. The station-wide effect of the total systems will be monitored during construction of the drydock using the on-station permanently metered observation wells.

After the drydock is constructed, only the first upland system pumping 1,200 gpm will be necessary. The artesian relief pumps at the shoreline and within the drydock can be removed. Wells within the drydock, however, will remain as "safety valves" in the event of an emergency associated with the on-shore water supply/aquifer relief system.

Aid With Housing

By WILLIAM L. HOWARD
Housing Management Officer
NAVFAC HQ
• Alexandria, Va.

Qualified Navy personnel may soon benefit from a new Department of Housing and Urban Development (HUD) program. The new program, referred to as *Section 8 Housing*, was authorized by Section 201 of the Housing and Community Development Act of 1974 (Public Law 93-383) which amended Section 8 of the National Housing Act of 1937.

HOUSING — Navy families may soon qualify for rental aid from the Department of Housing and Urban Development. Low income families will receive the difference between actual rent and what they can afford, based on an area's median income.

The Section 8 program provides that HUD will make rental assistance payments in behalf of eligible lower income families occupying approved newly constructed, substantially rehabilitated, or existing housing.

The payment will be the difference between the approved rent for the unit and the amount the family is required to pay, which is not less than 15% nor more than 25% of the family's adjusted income.

Eligible families are those whose income does not exceed 80% of the median income for the locality with adjustments for family size and unusual expenses.

Initial emphasis of the program is directed to existing housing. Navy families interested in applying for existing housing under the Section 8 program should contact the local Public Housing Authority (PHA) and make application for eligibility. If an applicant is determined eligible, a "Certificate of Family Participation" will be issued to the service member by the PHA and the family may then seek a suitable unit anywhere within the operating jurisdiction of the local PHA.

Prior to seeking a unit, the eligible applicant will also be informed by the PHA as to the rental rates and housing standards of the program. There is no requirement that a rental unit be committed to the program prior to being contacted by the eligible applicant.

When an acceptable unit is located, and the owner is willing to lease the unit under the provisions of the program, the PHA will determine if the housing is decent, safe and sanitary and the gross rent (utilities included) is within the HUD established Fair Market Rent for existing comparable housing.

A lease may then be executed between the owner and the family. A Housing Assistance Payment Contract will then be executed between the PHA and the owner in an amount sufficient to make up the difference between the rent payable by the family (15-25% of adjusted income) and the contract rent to the owner.

The law also authorizes HUD to execute an agreement with property owners, that upon completion of newly constructed or substantially rehabilitated projects, it will enter into a Housing Assistance Payments Contract with the owner for units occupied by eligible families. The approved contract rents may not exceed the HUD established Fair Market Rents for comparable units in the housing market area in which the project will be located.

Owners of such newly constructed units or substantially rehabilitated units will be responsible for all maintenance and management functions, including taking of applications, determination of eligibility, and revalidation of income. Personnel desiring to lease newly constructed or substantially rehabilitated housing should contact their military Housing Referral Office for the location of such units.

If the applicant is determined by the owner to be eligible, the owner will notify HUD who will initiate rental assistance payments to the owner.

HUD anticipates 400,000 units will be subsidized under the Section 8 program, and has allocated to its regional and area offices $900 million to supplement subsidy funds previously authorized for leasing housing.

The potential of the Section 8 program to provide adequate low cost housing for military personnel in the private community is substantial. Married enlisted personnel are particularly encouraged to check into the program at the earliest possible date for possible occupancy and subsidy benefits from this newest housing assistance program.

Let's take another look at management control systems

By LCDR JOHN P. BRENNAN, CEC, USN
Instructor
Defense Resources Management Education Center
Monterey, California

"The lack of awareness of what management control really means has caused Department of Defense agencies to needlessly waste money on information and control systems which are both over-complex and ineffective at the same time. The magnetism of computers draws us toward them with a powerful force; often causing managers to lose their perspective. This article goes back to some of the basics — and should help to restructure and recall the logical thought process by which engineers must work."

The engineer/manager today frequently is found in a situation where he or she must either plan, organize, or operate a control system to enable managerial direction of activities. We are familiar with net-working techniques such as CPM and PERT used in facilities management.

Morey Fos-Hati perhaps added a new acronym to our control vocabulary when he spoke of PROMAP (project management and planning), in the Fall issue of *The Navy Civil Engineer*. Sophisticated techniques such as these are not always necessary management tools, however. Less complex control techniques, which are also less costly, frequently can be valuable aids in exercising management control.

Today's engineer/manager must be familiar with the theory of management control in order to select or perhaps design a control system to satisfy his or her current needs, and which can be afforded within the scarce resources available.

Management control in the sense we will discuss is not control in the "power over things" sense. We are not discussing controlling crowds or floods; we are not talking about the pitcher who has good control. Neither are we talking about control in a subtle sense such as the influence of peers, relatives or neighbors over your behavior.

What we are talking about is control as a managerial function which embodies establishment of objectives, determination of a range of acceptable variation or deviation, development of a measurement or management information system, execution of the task of comparison between planned and actual performance, and then lastly, the application of corrective action.

These are essential elements of any managerial control system. The most important, and possibly the most difficult job in establishing a good control system is the establishment of objectives. Objectives are a cornerstone in each function of management.

Those having a managerial function must translate general organizational goals into specific quantified objectives. The objectives may be computed utilizing engineering or other scientific calculations. The design flow rate in a pipeline between a fuel depot and an air station is an example of this type of objective.

An objective may be based on what others have been able to achieve with similar resources. Par on a golf course, *Work In Place* per manday, or percentage of labor expended by *Labor Class Code* are good examples of this type of objective.

Objectives must be quantified. We find it very hard to know how well we're doing when we're given an objective to "reduce maintenance costs per mile for administrative use motor vehicles." How much? By when?

The objective must state the monetary or percentage reduction and the time frame in order for us to know how well

not 'power' control

actual performance compares to the objective and what we must do to bring actual performance into agreement with the objective.

Other managerial functions such as organizing, staffing, budgeting, directing, leading, and communicating all have a common purpose and that is to facilitate objective attainment. It matters not whether the objective is to meet the project completion date within quality standards or whether it is to achieve genuine equal employment opportunity within an

back to the drawing . . .

organization. One should not act without first establishing objectives.

Establishment of a range of acceptable variation or deviation serves to separate the wheat from the chaff. It also recognizes that performance will not always exactly meet the goal but rather that a range of performance data will generally result. By establishing the limits past which the project, job, or operation can be considered out of control the engineer/manager develops a screening device so that he or she can really manage by exception. Concentration on actual results which exceed established ranges of acceptable performance is therefore facilitated since the larger volume of satisfactorily performed work is not reported on.

Development of a management information system designed to collect data pertaining to measurement of actual performance involves a great deal of effort. Large quantities of scarce resources — time, people, money — are consumed not only in the design and development of such a system, but in its acquisition and continued operation and maintenance. Other aspects of a MIS are important to consider as well.

- Measure current performance in the same units as the objective is stated. This enables comparison and avoids the old apples and oranges counting game.
- Choose a time interval for reporting so that the units of measurement are in fact measured at that interval. For example, if production is already reported daily by man hours and weekly by dollars of Work In Place, choose that time interval which will generate the units you wish to measure — or be prepared to pay the increased cost and incur additional error.

Comparison of actual to desired performance in a properly structured control system becomes relatively easy. This step adds meaning to the data. Management reports which assist in executing the control functions should, by conforming to the previously discussed concepts, be strictly limited to jobs, processes, or situations out of control. Use of estimates of current performance in some cases will be necessary in order to obtain timely management information. This should not be bothersome however since we are interested in a general order of magnitude. Specific cases can be made more exact — if they warrant it — during detailed examination to find the cause of exceeding control limits.

The biggest hazards in taking corrective action are failing to take action when it is required or taking action when none is needed. These risks will still remain in any position of responsibility even with the best control system. It is important to view the action phase of the control process as having applicability to virtually all of the other control system elements. Perhaps the MIS that measures actual performance is faulty and must be corrected. Perhaps the performance is lacking in quality, quantity or timeliness, requiring attention. The plan developed to conduct operations to produce goods or services may be faulty. Perhaps the objectives were unrealistic in the beginning, unrealistic because they were unattainable within the time, people, or financial constraints prevailing.

There is nothing inherently wrong in having to revise a plan to achieve an objective, nor is there anything wrong in revising the estimate of the objective that can be achieved.

What is wrong is to be forced to change a plan, or to seek a lesser objective through neglect or a lack of control.

It is imperative to keep in mind the cost of control. If the benefits of control do not equal or exceed the costs of control then time and money are being wasted.

Information and control have their prices — someone has to pay the bill — there is no free lunch!

there's no free lunch

Advice of Counsel

By W. H. SPECK
Counsel, NAVFAC HQ

"Justice is the first virtue of social institutions, as truth is of systems of thought."

— John Rawls, A Theory of Justice (1974), p. 3

One need not be a lawyer or contract administrator to interpret plans and specifications or other legal documents; but the professional should do so much more rigorously, taking into account the following:

1. Law is a command expressed in language of statutes, regulations, contract terms, deeds, or wills; and the language must be carefully evaluated in terms of definitions, grammar, and rhetoric.

2. The command language was written and must be interpreted in a context of facts constituting its legislative history, negotiating background, trade usage, or execution circumstances.

3. Justice and fulfillment of expectations demand consistent, equal treatment so that previous interpretations from custom or precedent (stare decisis) must be taken into account and may determine meaning.

4. A hierarchy of law may apply: constitutions over statutes over regulations over contract terms with the written prevailing over the oral and precedential provisions applying. A still higher and vague natural law may be invoked, perhaps under guise of constitutional terms like "due process" or "equal protection" or "public policy."

5. Rules of interpretation may be applied, such as that the contract will be construed as a whole, or that it will be interpreted most strictly against the drafter.

6. Justice construes statutes, contracts, plans, and specifications to make them work so that where the legal obligation is to sue in a non-existent court, to pay at an exchange rate no longer determined, or to do the impossible or even business impracticable, courts find a feasible way or excuse.

7. Perfectly good rights may fail for the wrong procedural course or untimeliness; but tribunals liberally overlook such failures.

8. Perfectly good rights may be subject to equitable defenses such as waiver (knowingly giving up), estoppel (allowing another to change position to his disadvantage without claiming right), or laches (lapse of time plus change of position).

9. The lawyer can often only fully interpret after preparing a trial brief (an outline of legal authorities and evidence pro and con) and weighing the litigative risk of each possible course.

Sea(bee) Stories

Hard Hearted Merry Christmas

By LCDR A. N. OLSEN, CEC, USN

In early December 1963 MCB-9 boarded the *USNS Mitchell* at Okinawa and headed for Port Hueneme, Calif., for Christmas at home after being relieved as the Pacific Alert Battalion. The route home included a stop at Inchon, Korea, to disembark several hundred Army troops.

Due to the extreme tide range at Inchon, the *Mitchell* anchored out. Troops moved from the ship onto a short causeway section alongside and then into Mike boats which ferried them to the beach.

The weather at Inchon was miserable. There were cold, high winds and rough seas. When the time came for the troops to go ashore, I found half the battalion on deck manning the life lines.

Was this a formal farewell to their Army buddies? Not by a long sight!

These hard-hearted and homeward-bound Seabees waited until the soaked, miserable, and by now seasick soldiers had been loaded aboard the Mike boat and had backed away from the end of the causeway. Then, during the momentary silence when the coxswain idled the engine to reverse the screw, they all shouted in unison, "Merry Christmas!"

Capt Clements Selected Rear Admiral

The President has approved the recommendation of the Civil Engineer Corps Flag Selection Board that Captain Neal Woodson Clements be promoted to the rank of Rear Admiral.

He is presently serving as the Deputy Commander for Facilities Acquisition, at the Naval Facilities Engineering Command Headquarters, Alexandria, Virginia.

Captain Clements was born on August 5, 1926, in Crockett, Texas and is a graduate of the U.S. Naval Academy, class of 1949.

In Vietnam he served as the Assistant Officer in Charge of Construction for Engineering and Planning.

In August 1972 he became the Commander, Naval Construction Battalions, U.S. Atlantic Fleet, with Headquarters at the Naval Construction Battalion Center, Davisville, Rhode Island.

Captain Clements is married to the former Ann Buck of Muskogee, Oklahoma. He is the brother of Jamie H. Clements of Temple, Texas.

One of his sons is LTJG Neal W. Clements, Jr., CEC, USN, on duty at the Naval Weapons Station, Earl, New Jersey. Midshipman Mark H. Clements is a member of the Class of 1976 of the U.S. Naval Academy.

SPEAKING FROM TOPSIDE:

...a new direction for the controlled maintenance program

One of the major problems facing the Navy today is the maintenance of the Shore Establishment. To those of us who daily grapple with deteriorating facilities the problem is obvious, even demanding, and the solution is simple: send money to the Public Works Officer and let him maintain his station in accordance with good engineering and management standards.

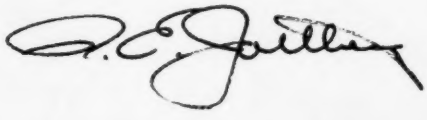
Insofar as managing a maintenance and repair program most of us feel we are on solid footing. Approximately twenty years ago the Bureau of Yards and Docks developed the concepts of the Controlled Maintenance Program. Since its inception it has been implemented throughout the Navy, modified and improved, and continues as the fundamental management approach to applying the resources made available to facilities maintenance and repair. This program has been so successful in assuring that Navy real property resources have been effectively used that it has been copied and applied in many other government and private industry facilities maintenance operations.

Notwithstanding the success of the Controlled Maintenance Program the Navy's shore establishment now has many problems. Advanced deterioration threatens readiness in many areas. In recent years resources available for maintenance and repair have been so limited that there has been a tendency to revert to a semi-breakdown maintenance approach — abandoning many of the principles of controlled maintenance. This has been particularly true for the continuous inspection effort. The argument has been — "why inspect this year when there was so little money available last year to correct the problems identified last year?" The result has been an inaccurate record of the total requirement for maintenance and repair resources and therefore weak justification for real property budget requests.

In restrospect as Navy Civil Engineers, while we emphasized the effective use of available resources, we have failed to use the Controlled Maintenance Program's potential for defining requirements and justifying budget requests. As the Inspection Program has atrophied, so has this potential and we now are in a very poor position to convince the decision makers in the Navy and at higher levels that more resources are required. At the higher levels, Navy programs must be evaluated not only on their absolute needs but also on their relative importance to Navy readiness recognizing that the Navy's limited resources cannot fully fund all programs. The definition of real property maintenance requirements as they effect operational readiness, therefore, becomes extremely important.

From my position as Director, Shore Facilities Programming Division in OPNAV, I am implementing some new concepts to help define our requirements better. A renewed inspection program is vital to this new effort, and we will use inspection results in a more effective way. In the past the aggregate of all activities inspections has determined the Navy's Backlog of Maintenance and Repair (BMAR). At the CNO level we have talked about the continuing growth of BMAR for years. BMAR growth has not been accepted, however, as a convincing argument for resources. It is not an effective indicator of our requirements by itself. The new approach will not focus on the level of the BMAR but on the significance of the BMAR. We will focus on the conditions of our facilities not exclusively on the deficiencies. The new approach will produce an assessment of the condition of the facilities in each class of facilities and the potential for impact on readiness of this condition over the forthcoming five years. These assessments will be derived from the Continuous Inspection Program. Each major claimant will provide his assessments with the Annual Inspection Summaries for his activities in conjunction with his budget submissions. The total Navy assessments will be prepared in OPNAV and will be used to portray to the CNO and higher authority the full, long term significance of their resource allocation decision. With each annual cycle the assessments and the resource allocation decisions will be adjusted for the ensuing five year period. Thus, we hope to present our requirements and obtain resources on a stable, continuing basis relative to Navy readiness.

This is a very brief discussion of efforts underway to improve the management of the maintenance and repair of Navy shore facilities. Official direction will be provided by a forthcoming issue of CNO INSTRUCTION 11010.23. An understanding by all Navy Civil Engineers is important, however, since most will be involved, directly or indirectly.



By RADM ROBERT F. JORTBERG, CEC, USN

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